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## FINAL REPORT

6

# SPACE-SHUTTLE INTERFACES/UTILIZATION

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SATELLITE SYSTEM DEFINITION STUDY (EOS)
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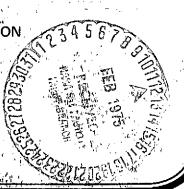
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## EARTH OBSERVATORY SATELLITE SYSTEM DEFINITION STUDY (EOS)

PREPARED FOR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER

IN RESPONSE TO (CONTRACT NASS-20519





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#### 1. INTRODUCTION

This report presents the economic aspects of Shuttle application to a representative EOS-type operational mission in the various candidate Shuttle modes: launch, retrieval, and resupply. System maintenance of the same mission capability via a conventional launch vehicle is also provided.

Development of the Space Shuttle is the beginning of an era in which space programs can be planned around a nonexpendable maintenance philosophy. Cost savings can be realized both from launch vehicle reuse and from spacecraft hardware salvage and reapplication. The conceptual and detailed design of the EOS has been carried out with this on-orbit maintenance capability in mind, providing for spacecraft retrieval and/or on-orbit replacement of subsystem modules (Reference 1).

The extent to which the cost-saving potential offered by Shuttle can be realized will depend upon the details of module/spacecraft design, as well as the policy employed in scheduling Shuttle flights. As an example, there is a definite cost tradeoff in selecting the redundancy within spacecraft modules; low redundancy will yield short mean-times-to-failure (MTTFs) and frequent Shuttle flights, while excessive redundancy may cause the spacecraft cost and weight to be unacceptable. Other issues include the desirability of preventive maintenance (e.g., replacing a module which has experienced only noncritical failures), tradeoffs between resupply and retrieval, whether to service in the operational orbit or to deboost for low altitude servicing, and whether to implement a particular mission with a single or with multiple satellites.

The studies documented here are based on application of a sophisticated Monte Carlo mission simulation program developed originally for studies of in-space servicing of a military satellite system via a Shuttle-Tug system (Reference 2). This program, which allows detailed modeling of the spacecraft modules at the component level (e.g., cost, failure rates, redundancy configuration), has been modified to permit evaluation of Shuttle application to low-altitude EOS missions in three modes: launch-only, retrieval, and resupply.

In the course of these studies it has become apparent that this existing mission cycle costing program has features which, when coupled with schedule and fiscal constraints of the EOS system study, limit the types of missions which can be evaluated. These limitations are noted in the appropriate sections of this report and a final section recommends future study tasks which will enhance mission planning. It should be noted, however, that these restrictions have not prevented achieving the objective of this study — that is, a cost comparison of Shuttle application modes for representative EOS operational missions.

The mission simulations performed in the course of the EOS system study have led to the following conclusions:

- Reduced mission cost and increased satellite availability can be gained by increased levels of satellite redundancy
- Shuttle servicing provides significant advantages over an expendable system maintenance approach
- For expendable operation, Shuttle launch is more cost effective than use of a conventional launch vehicle
- Resupply is significantly more cost effective than retrieval
- Preventive maintenance flights (i.e., initiated to prevent loss of deboost capability) improve availability but increase the total mission cost
- Reduced launch delay improves availability but increases total mission cost.

These conclusions are discussed in Section 6, where it is noted that they are dependent on the models and data based used. In particular, the cost algorithm used to assess the EOS program for Shuttle use is a sensitive factor.

#### 2. PROBLEM DEFINITION

#### 2.1 MISSIONS

The study RFP defined a research and development EOS-A mission with a thematic mapper (TM) plus high-resolution pointable imager (HRPI) payload. During the course of the study a variety of alternate operational and R&D payloads have been discussed, including spacecraft with single instruments, tandem (skewed) instruments, redundant instruments, etc. (Reference 3).

The most commonly considered operational instrument has been the 5-band multispectral scanner (MSS), a sensor based upon the ERTS-flown MSS. The basic mission chosen for study of Shuttle servicing is a single satellite having a single 5-band MSS and a compatible wideband communications and data handling (WBCDH) module (the latter including video tape recorders), with the payload redundancy level (within the WBCDH and MSS) considered as a study parameter. Selection of this mission has been motivated by a variety of factors, including:

- Owing to its advanced state of development, definitive reliability and design data is available for the 5-band MSS (Reference 4).
- The relative merits of the Shuttle application modes should not depend strongly upon the specific payload flown.
- A simple mission (i.e., single satellite with a single sensor)
  will yield data most easily understood; its evaluation is a
  necessary precursor to study of more complex situations.

Study of alternate missions (e.g., satellites with tandem instruments providing degraded coverage frequency in the event of failure of one instrument; multisatellite systems, where loss of a single satellite yields degraded coverage; and, payloads with advanced instrument payloads) is a suggested future task.

#### 2.2 SHUTTLE APPLICATION MODES

The Space Shuttle can be used to maintain an operational EOS in three distinct ways:

1) Launch Only. The initial satellite is launched via Shuttle. When it fails it is replaced by a new satellite, with the failed space-craft left in orbit. This mode is equivalent to use of a

conventional launch vehicle, the only difference being in the launch vehicle cost and availability.

- 2) Launch and Retrieve. The initial satellite is launched via Shuttle. When it fails it is replaced by a new satellite, with the old satellite retrieved from orbit and refurbished on the ground for subsequent reuse.\*
- 3) Launch and Resupply. The initial satellite is launched via Shuttle. When it fails it is repaired in orbit by replacing the appropriate modules using the Shuttle Flight Support System. \*

Figure 2-1 illustrates these three system maintenance modes.

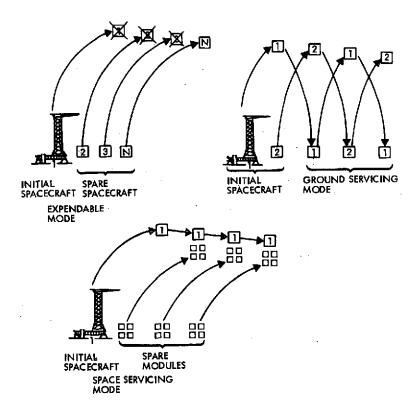


Figure 2-1. System Maintenance Modes

<sup>\*</sup>Resupply and retrieval flights are generally planned prior to ultimate failure of the spacecraft; the servicing logic is delineated in Section 3.2.

#### 2.3 ASSUMPTIONS AND GROUNDRULES

In addition to the models defined in the following section, a number of groundrules have been established for mission tradeoffs. Some of these are obvious decisions, while others suggest areas for future study.

- The spacecraft module designs reported in Reference 1 have been employed. In particular, propulsion and control actuation equipment are in a common module (actuation module).
- All initial Shuttle launches will be to low altitude (100 n mi circular orbit), with insertion into the operational orbit (375 n mi) via spacecraft propulsion. In the expendable launch-only mode all subsequent launches will also be to low altitude.
- Shuttle servicing flights (retrieve or resupply) will be to low altitude, unless the spacecraft has experienced a failure which prevents its deboost to the 100 n mi circular orbit.
- All retrieval flights will include replacement with a new satellite.
- The actuation module will always be replaced on low altitude resupply flights, in order to renew the orbit transfer propellant. On high altitude resupply flights it will be replaced only if it satisfies the replacement criteria applied to other spacecraft modules (Section 3.2).
- A fixed-mission duration by 10 years is used in all runs. The basic outputs of interest are cost per year of system operation and availability percentage.
- Only recurring spacecraft and launch vehicle costs are considered. Ground operation costs and nonrecurring costs are not significantly dependent upon the parameters being traded.
- All equipment failures are on-orbit satellite failures. Shuttle failures, for example, are not considered.
- Following a Shuttle-maintenance flight decision, there is a fixed delay until the flight is actually made; this delay is a parameter of the study. An alternate approach would be to manufacture modules on a prescribed schedule and suffer varying launch delays in cases of inventory depletion; this more refined and detailed model can be considered as a topic for future study.

#### 3. METHOD OF EVALUATION

Mission cycle costing studies have been carried out using the TRW mission simulation evolved during previous studies, modified and enhanced during the EOS system study. This section describes the general characteristics of the mission costing program (described in greater depth in Appendix A) and the manner in which it has been adapted to EOS.

#### 3.1 TRW MISSION SIMULATION

The TRW mission simulation treats Shuttle-serviced satellite systems via a Monte Carlo simulation technique. In its most general form it simulates all phases of a space mission: spacecraft manufacturing, launch vehicle scheduling, Shuttle-spacecraft mating, launch, onorbit operation, etc. This detailed capability is described in Appendix A.

For the present discussion it is sufficient to consider the manner in which on-orbit operation is treated. The satellite itself is modelled by an input-specified array of space-replaceable units (SRU's) and non-replaceable units (NRU's), where, for EOS, the SRU's correspond to the resuppliable modules (spacecraft and payload) and the single NRU is composed of the nonmodular elements (spacecraft structure, payload support structure, transition ring, adapter, etc.) Each module is represented as a set of component groups, that is, redundancy groups, with each group having an input-specified redundancy configuration and each component within the group having a selectable reliability model (e.g., exponential with MTBF as input data).

To evaluate a specific mission case, a number of runs (typically 100) are made and evaluated statistically. Each run consists of a sequence of events defined by an order of component failures on board the orbiting space-craft and a corresponding set of maintenance activities. The event sequence for a particular run is established in a random manner by selecting a random number between zero and one for each component and using the inverse of the reliability relationship to establish the random failure time; for an exponential reliability model the time of failure for any component

is given by

$$T_{f} = -\frac{1}{\lambda} \ln R \tag{1}$$

where R is the randomly selected reliability and  $\lambda$  is the failure rate of that component.

Within the modules (SRU's and NRU's) each component group is classified as one of four types:\*

- <u>Class 0</u>. Noncritical. Loss of such a group will endanger neither the mission nor the spacecraft.
- <u>Class 1</u>. Mission Critical. Loss of such a group will abort the mission but will not endanger the satellite.
- Class 2. Transfer Critical. Loss of such a group will prevent orbit transfer, preventing deboost for low altitude servicing, but will not endanger the satellite.
- Class 3. Survival Critical. Loss of such a group will cause loss of the satellite.

Note that failure of a group means fewer components are functional than are required; for example, if three gyros are needed and six are provided (3/6 redundancy), the third gyro failure makes the group one failure away from loss and the fourth gyro failure signals loss of this component group.

The decision to schedule Shuttle maintenance flights and the modules to be replaced (on a resupply flight) are based on the concept of module state defined in Table 3-1. Note that the module state is taken to be the highest (numerically longest) one determined by evaluating each of its constituent component groups according to the definitions in Table 3-1. Similarly, the satellite state is the highest of its module states.

As noted above each run generates a random sequence of events (i.e., component failures). Each event is evaluated, in sequence, to determine if it causes a change in state. When the state of the satellite

<sup>\*</sup>The "transfer critical" class has been introduced specifically for EOS, to allow a meaningful discrimination between high-altitude and low-altitude serviceability.

Table 3-1. Module State Definition

State	Definition
0	No component failures; initial state
1	Component failure in Class 0 group
2	Loss of Class 0 group
3	Unassigned
4	Component failure in Class 1, Class 2 or Class 3 group
5	Class 1 group is one failure away from loss
6	Class 2 group is one failure away from loss
. 7	Class 1 group is lost
8	Class 3 group is one failure away from loss
9	Class 2 group is lost
10	Class 3 group is lost (loss of satellite)

becomes sufficiently high, a service flight is scheduled. For pre-EOS studies, involving multiple satellites serviceable on the same shuttle flight, the servicing policy was as follows:

- A service flight is initiated due to loss of operation or being one failure away from loss of any spacecraft.
- A replacement flight will replace all SRU's in State 5 or higher on all satellites, if possible within the Shuttle payload weight and volume limit. If not possible, modules are replaced according to the following priority scheme:
  - 1) Replace all State 5 SRU's on the satellite causing the flight, if this is not possible, replace those with the lowest component group MTBF's (i.e., most likely to fail in the future) in ascending order until the weight or volume limit is reached.
  - 2) If Shuttle payload capacity permits servicing of additional satellites, scan all satellites for State 5 SRU's to find those most likely to fail in the future. Select such modules in order to ascending MTBF until Shuttle weight or volume limit is reached.

This service policy has been modified for EOS consistent with the added component class and the revised state structure. Note, also, that weight/volume limits are never exceeded for the single satellite EOS system defined in Section 2.1, but could be in a two (or more) satellite system.

The resupply/rework costing model employed for pre-EOS studies has assumed a rework cost which is a specified percentage of the initial module cost. For EOS, a refined model which takes into account knowledge of which components within the module have failed has been programmed.

#### 3.2 ADAPTATION OF EOS STUDY

Application of the TRW mission simulation to EOS system maintenance studies has required alteration of the servicing logic and refinement of the costing model.

#### 3.2.1 Maintenance Models

System maintenance logic can be considered for each of the Shuttle application modes. In general, two issues must be dealt with - when to make a Shuttle flight and what maintenance activities to undertake at that time (for example, what state is employed as a replacement criterion on a resupply flight). Questions of Shuttle payload limits are not an issue for a single satellite system with the orbits and designs defined in Section 2.3 and so will not be considered further (if required the priority logic defined earlier would automatically come into play).

#### 3.2.1.1 Launch-Only Mode

This is the simplest mode to consider. For these evaluations, a replacement flight is scheduled only after failure of the in-orbit satellite to perform its mission due to loss of a component group classified other than Class 0.\* Scheduling Shuttle flights prior to spacecraft outage is an optional alternative; however, since the satellite in orbit cannot be retrieved for its "salvage" value in this expendible mode, the primary motivation for survival-based flights is negated, leaving the only gain an increase in availability.

The maintenance action in this mode is replacement of the failed satellite with a new one.

<sup>\*</sup>Operation could continue after failure of certain Class 2 and Class 3 elements (e.g., the hydrazine system). However all such ambiguous component groups are very reliable, making this model a realistic one.

#### 3.2.1.2 Launch-and-Retrieval Mode

When the Shuttle is used for retrieval or on-orbit module replacement (resupply), both high and low orbit servicing must be considered. This is because the GSFC-specified Shuttle cost algorithm (see Section 3.2.2) favors low altitude servicing whenever the state of equipment on board the satellite permits its transfer to and rendezvous with the Shuttle at these altitudes. To consider this factor in the framework of the existing simulation, Class 2 has been defined to be transfer-critical equipment; that is, loss of a Class 2 group will prevent satellite deboost, thus requiring a high-altitude Shuttle service flight.

The baseline Shuttle flight logic, therefore, is to initiate Shuttle service flights whenever a failure results in any one of the following criteria being met (See Table 3-1):

- One failure away from loss of deboost capability (State 6)
- Loss of operational capability (State 7)
- One failure away from loss of satellite (State 8)
- Loss of deboost capability (State 9).

If the satellite is lost (State 10), it is replaced by a new one, with no resupply/retrieval of the old one.

Normally service flights will be made at low altitude, using the on-board satellite to deboost. However, if the satellite is in State 9 the capability to deboost has been lost, and the Shuttle must rendezvous with the satellite at high altitude.\*

The baseline logic defined above can force a relatively large number of Shuttle flights, unless Class 2 equipment is made highly redundant. There is a tradeoff between flying early to permit lowaltitude servicing a high percentage of the time or waiting to yield fewer flights which are, on the average, more costly due to increased Shuttle costs. This alternate servicing logic has been studied by deletion of Shuttle flights based on State 6.

<sup>\*</sup>The alternative of "writing-off" the satellite rather than allowing high flights can be evaluated by reclassifying all Class 2 components as Class 3. This option appears unattractive and has not been evaluated at this time.

When retrieval flights are made, a new satellite is deployed, at the altitude from which the other spacecraft is retrieved (high or low). The elements of the retrieved satellites, modules as well as nonreplaceable units, are reworked and returned to inventory for future application. In this rework all failed components are replaced. The costing algorithms associated with retrieval are defined in Section 3.2.2.

#### 3.2.1.3 Launch-and-Resupply

Shuttle flights for resupply are scheduled on the same basis as retrieval flights, as discussed above. When resupply flights are made, all modules in which there have been any Class 1, 2 or 3 component failures are replaced. Alternate policies (e.g., replace only modules which have a component group one away from loss) may be appealing in weight limited situations but are probably not in this case.

The actuation module, containing the orbit transfer propellant is treated somewhat differently: it must be replaced on all low-altitude resupply flights (in order that the spacecraft can regain its operational altitude); on high-altitude resupply flights its replacement criterion is the same as any other module.

#### 3.2.2 Cost Models

Three distinct cost elements are simulated: launch vehicle costs, initial (new) spacecraft costs, and spacecraft replacement/resupply costs.

#### 3.2.2.1 Shuttle Costs

The general relationship employed to charge the EOS program for a Shuttle flight is:

$$C_s = K W_{EOS}$$
 (2)

where W<sub>EOS</sub> is the weight of the satellite plus the Shuttle flight support system (FSS):

$$W_{EOS} = W_{SAT} + W_{FSS}$$
 (3)

For conventional launch vehicles, the cost is a fixed parameter; see Reference 3.

and K, the cost coefficient, is the ratio of the total Shuttle flight cost to its payload capability to the altitude of interest. The payload capability depends upon altitude and, to a lesser extent, upon whether a rendezvous. is required (as in retrieval and resupply). The FSS weight will depend upon whether the on-orbit replacement system (SPMS) is on board. Section 4.1 defines these coefficients for each Shuttle mode and service altitude.

It should be noted that all Shuttle flights are costed assuming a two-way (ascent and descent) trip carrying the same weight. In a launch-only mode, it is assumed that no other program can make use of the additional descent weight capability. All other flights retrieval/replacement and resupply are inherently two-way.

#### 3.2.2.2 New Satellite Costs\*

The satellite (observatory) consists of payload modules (SRU's), spacecraft modules (SRU's), and a nonreplaceable unit (NRU) which includes the satellite structure, harnesses, transition ring, interstage adapter, etc. If the satellite consists of J such elements, the total cost of a new satellite is given by

$$C_{SN} = C_{SO} + \sum_{j=1}^{J} C_{jN}$$
 (4)

where

- C<sub>iN</sub> is the new cost of the j<sup>th</sup> element (SRU or NRU)
- C<sub>SO</sub> is the fixed spacecraft build cost (costs which do not depend upon the module costs).

The new cost of any satellite module is given by:

$$C_{jN} = C_{oj} + k_{1j} \sum_{n=1}^{N} C_n + k_{2j} \sum_{m=1}^{M} C_m$$
 (5)

<sup>\*</sup>As noted earlier, only recurring satellite costs are considered.

where

 $C_{iN}$  is the delivered total cost of module j

C<sub>oj</sub> is the fixed module build cost (costs which do not depend upon the component costs)

k<sub>lj</sub> is the cost weighting factor for module j hardware built in house

k<sub>2j</sub> is the cost weighting factor for module j hardware built outside

N is the total number of components (boxes) built in-house

M is the total number of components (boxes) procured outside

Cn, Cm are the component hardware costs

The data base for the cost model is presented in Section 4.1

#### 3.2.2.3 Satellite Replacement/Resupply Costs

The cost of satellite replacement or resupply can be developed based upon the modelling approach just presented. First note that if a module fails in-orbit the immediate cost of its replacement is equal to  $C_{jN}$ . But since the returned module can be refurbished and returned to inventory, the net cost of replacement (resupply or retrieval/replacement) is

Therefore, on a module basis:

$$C_{iR} = cost of rework$$
 (7)

And as with a new satellite, the total replacement/resupply cost will be

$$C_{SR} = C_{RO} + \underbrace{\sum_{j_F} C_{jR}}_{reworked/replaced}$$
modules only
(8)

where

C<sub>jR</sub> is the rework cost of the j th element (SRU only for resupply, SRU or NRU for retrieval)

C<sub>RO</sub> is the fixed spacecraft rework cost (costs which do not depend upon the module costs).

The module rework costs can be developed according to the following equation:

$$C_{jR} = \frac{N_f + M_f}{N + M} \cdot C_{oj} + k_{1j} \sum_{N_f} C_n + k_{2j} \sum_{M_f} C_m$$
 (9)

where  $N_f$  and  $M_f$  are the number of failed components in each category and the summations are carried out only over the reworked elements. Note that  $N_f = N$ ,  $M_f = M$  is a complete rework, costing the same as a new module.

#### 4. STUDY DATA BASE

#### 4.1 SHUTTLE DATA BASE

The Shuttle cost coefficient, K, is given by

$$K = \frac{\text{total shuttle launch cost}}{\text{total shuttle weight capability}} = \frac{\$9.8 \text{ M}}{W_S} \cdot \frac{1}{\eta}$$
 (10)

where \$9.8 M is the total cost of a Shuttle flight (up and down) and  $\eta$  is the Shuttle load factor (here taken as 0.70).

The various coefficients and weights employed in the Shuttle flight cost model presented earlier are presented in Table 4-1.

Low Altitude High (100 n mi (375 n mi Mode Sun Synchronous) Sun Synchronous)  $W_{g} = 11,000 \text{ lb}$  $W_{g} = 37,000 \text{ lb}$ Launch K = 378.37\* $K = 1272.73^*$ No Rendezvous  $W_{FSS} = 1372 lb$  $W_{FSS} = 1372 lb$  $W_s = 8,800 \text{ lb}$  $W_s = 35,000 \text{ lb}$ Retrieve K = 400.00K = 1590.91 $W_{FSS} = 1372 lb$  $W_{FSS} = 1372 \text{ lb}$ Rendezvous Required  $W_{g} = 8,800 \text{ lb}$  $W_{g} = 35,000 \text{ lb}$ Resupply K = 400.00K = 1590.91 $W_{FSS} = 2472 \text{ lb}$  $W_{FSS} = 2472 lb$ 

Table 4-1. Shuttle Costing Parameters

Note that the values shown for K favor low altitude servicing, unless there is a significant accompanying increase in the number of Shuttle flights and/or the cost of the spacecraft.

<sup>\*(</sup>K in dollars/lb)

#### 4.2 SATELLITE DATA BASE

As modelled in the mission simulation, the satellite consists of five replaceable spacecraft modules; two replaceable payload modules, and a single nonreplaceable unit. The following sections present the detailed cost, weight, redundancy, and reliability models employed.

#### 4.2.1 Spacecraft

The spacecraft modules are defined in Tables 4-2 through 4-6 for five redundancy configurations:

- Minimum minimum redundancy necessary to ensure no single-failure preventing retrieval or resupply.
- Variant 1 limited additional redundancy.
- Variant 2 still more redundancy.
- Nominal most electronics made standby redundant; "typical" redundancy level for long-life spacecraft.
- Growth added replication of Class 2 items in order to reduce the frequency of servicing flights.

Within the tables several notational conventions require explanation:

- λ is the number of failures per hour (all components are modelled with exponential reliability)
- 2) Source l is a "make", 2 a "buy".
- 3) S indicates standby redundancy, A active redundancy, and AS indicates one actively redundant unit with other redundant components in standby.

Note that the weights shown are generally a function of the Shuttle application mode. However, for all but the actuation module, the launch-only weight and the retrieval weight are the same.

The mission simulation, as presently configured, has no provisions for scheduling flights based on component degradation. This omission is of significance for EOS in the case of the solar array due to its high cost and high reliability (i.e., no replacement due to random failure is likely). The implications of this factor are complicated further by the fact that an array design providing a particular operational life will allow space-craft retrieval/resupply at times well in excess of this time due to lower nonoperational power requirements. The results presented below should be evaluated noting that array degradation has not been considered.

Table 4-2. Actuation Module Description

						R	edundan	cy Coni	iguratio	ns			
Compo	nents	· · · · · · · · · · · · · · · · · · ·		Mini	mum	Var	iant l	Vari	ant 2	Non	ninal	Gro	wth
Name	λ(x10 <sup>9</sup> )	Cost (\$K)	Source	Red.	Class	Red.	Class	Red.	Class	Red.	Class	Red.	Class
					_			,,,		. , ,	3	1/1	
Structure	0	24, 0	1	1/1	3	1/1	3	1/1	3	1/1	1		3
Module thermal control	10	18.0	1	1/1	1	1/1	1 1	1/1	1	1/1	1	1/1	1
Propulsion thermal control	10	11.5	1	1/1	2	1/1	2	1/1	2	1/1	2	1/1	2
Roll reaction wheel	150	52.0	2	.1/1	1	1/1	1	1/1	1	1/1	1	1/1	1
Pitch reaction wheel	. 150	52.0	2	1/1	1	1/1	1	1/1	1	1/1	1	1/1	1
Yaw reaction wheel	150	52.0	2	1/1	1	1/1	1	1/1	1	1/1	1	1/1	1
Roll wheel electronics	3235	26.0	1	1/1	1	1/2 S	5.1 7	1/2 S	1	1/2 S	1	1/2 S	1
Pitch wheel electronics	3235	26.0	1	1/1	1	1/25	1	1/2 S	1	1/2 S	1	1/2 S	1
Yaw wheel electronics	3235	26.0	1	1/1	1	1/2 S	1	1/2 S	1	1/2 S	1 .	1/2 S	1
Roll magnetic torquer	100	8.0	1 1	1/1	1	1/1	. 1 -	1/1	1	1/1	1	1/1	1
Pitch magnetic torquer	100	8.0	1	1/1	1	1/1	1	1/1	1	1/1	1,	1/1	1
Yaw magnetic torquer	100	8.0	1	1/1	1 .	1/1	1	1/1	1	1/1	1	1/1	1
Magnetic torquer electronics	2700	25.0	1	1/1	1	1/1	I	1/1	1	1/1	1	1/2 S	1
DIU/SCU	4632	42.0	1	1/1	2	1/1	2	1/25	2	1/2 S	2	1/3 5	2
Cold gas system	12	245.0	1	1/1	3	1/1	3	1/1	. 3	1/1	3	1/1	3
Hydrazine system	342	175.0	1	1/1	2	1/1	z	1/1	2	1/1	2	1/1	2
Harness	0	16.0	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
	Launch	only weigh	t (lb)		569	5	591	6	00	6	05	6	24
	Retries	val weight (l	.b)	10	006	10	38	10	52	1060		1086	
	Resupp	ly weight (I	ь)	13	215	12	248	12	261	17	270	12	.96

 $C_0 = $45.0K; k_1 = 1.32; k_2 = 1.50$ 

Table 4-3. Altitude Determination Module Description

			-				Redund	ancy Co	nfigurat	ions			
Com	ponents			Mini	mum	Var	iant l	Vari	iant 2	Nominal		Gro	wth
Name	λ (x10 <sup>9</sup> )	Cost (\$K)	Source	Red.	Class	Red.	Class	Red.	Class	Red.	Class	Red.	Class
								. ,.	_				
Structure	0	. 19,6	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
Module thermal control	10	18.0	1	1/1	1	1/1	1	1/1	1	1/1 -	1	1/1	1
Gyro reference assembly	16682	80.0	2	3/3	2	3/4 S	2	3/45	2	3/6 S	2	3/6 S	2
Star tracker	5256	69.0	2	2/2	1 1	2/3 S	1	2/3 S	1	2/3 S	1 -	2/3 S	1
Magnetometer	1400	20.0	2	1/1	2	1/1	2	1/1	2	1/2 S	2	1/3 S	2
Sun sensor*	232	44.0	2	1/1	0	1/1	0	1/1	O	1/1	0	1/1	0
Transfer assembly A	9500	27.5	1	1/1	2 .	1/2 S	2	1/25	2	1/2 S	2	1/3 S	2
Transfer assembly B	9500	27.5	1	1/1	1	1/2 5	1	1/2 S	1	1/2 S	1	1/25	1
Safe mode electronics*	348	7.0	1	1/1	0	1/1	0	1/1	0	1/1	0	1/1	0
Power conditioning	2500	25.0	1	1/2 S	3	1/2 S	3	1/25	3	1/2 S	3	1/25	3 -
DIU/SIU	4632	56.0	1	1/1	2	1/1	2	1/25	2	1/2 S	2	1/3 S	2
Harness	0	16.0	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
	Launch	only weigh	t (1b)	17	2.7	20	9.5	21	3.9	23	3.8	25	1.3
Retrieval weight (lb)			b)	17	2.7	.20	9.5	21:	3.9	233.8		251.3	
	Resupp	ly weight (11	) ·	19	6.1	23	2.9	23	7.3	25	7.2	27	4.7

<sup>\*</sup>The sun sensor and safe mode electronics are modelled as Class O because they will not be employed continuously until other equipment malfunctions have caused scheduling of a maintenance flight.

$$C_0 = $90.K; k_1 = 1.29; k_2 = 1.12$$

Table 4-4. Communication and Data Handling Module Description

						R	edundan	cy Con	figuratio	ns			
Components				Mini	imum	Var	iant l	Vari	iant 2	Non	ninal	Gro	wth
Name	λ(x10 <sup>9</sup> )	Cost (\$K)	Source	Red.	Class	Red,	Class	Red.	Сіавв	Red.	Class	Red.	Class
Structure	0	19.6	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
Module thermal control	10	13.9	1	1/1	1	1/1	1	1/1	1	1/1	1	1/1	1
Omni antenna system	20	20.0	2	1/1	2	1/1	2	1/1	2	1/1	-2	1/1	2
Transmitter	1708	43.0	2	1/1	2	1/1	2	1/1	2	1/2 S	2	1/3 S	2
Receiver	4021	65.0	2	1/1	2	1/1	2	1/1	2	1/2 A	2	1/3AS	2.
Diplexer	1:20	32.0	2	1/1	2	1/1	2	1/1	2	1/1	2	1/1	2
Demod/decoder	463	30.0	1	1/1	2 ·	1/1	2	1/1	2	1/2 A	2	1/3AS	2
Bus controller	3652	20.0	1	1/1	2	1/1	2	1/2 S	2	1/2 S	2-	1/3 S	2
Baseband assembly	1147	12.0	1.	1/1	. 2	1/1	. 2	1/1	2	1/25	2	1/3 S	2
Power conditioning	2500	25.0	1	1/1	2	1/1	.2	1/2 A	2	1/2 A	2	1/3AS	2
Combiner/switch	240	6,5	2	1/1	2	1/1	2	1/1	2	1/1	2	1/1	2
Central processor	7000	45.0	2	1/1	. 2 -	1/2 S	2	1/2 S	2	1/2 S	2	1/3 S	2
Memory module	3429	35.0	2	2/2	2	2/3 S	2	2/3 <b>S</b>	2 ·	2/3 S	2	2/4 S	2
DIU/SCU	3416	22.0	1	1/1	2	1/1	2	1/2 S	2	1/2 S	2	1/3 S	2
Harness	0	15.0	1	1/,1	Z	1/1	2	1/1	2	1/1	2	1/1	2
	Launch	only weigh	t (1b)	<sup>5</sup> .14	6.4	15	7.7	16	5.2	170	0.7	19	7.8
	Retriev	al weight (1	ь)	14	6.4	15	7.7	16	5. Ż	17	0.7	19	7.8
	Resupp	ly weight (ll	<b>)</b>	16	9.8	18	1.1	18	8.6	19	4,2	22	1.3

 $C_0 = $90.0K; k_1 = 1.29; k_2 = 1.12$ 

Table 4-5. Solar Array and Drive Module Description

						Re	edundan	cy Conf	iguratio	ns		<del>,</del>	
Components		•		Mini	mum	Vari	ant l	Vari	ant 2	Nom	inal	Gro	wth
Name	λ( <b>x</b> 10 <sup>9</sup> )	Cost (\$K)	Source	Red.	Class	Red.	Class	Red.	Class	Red.	Class	Red.	Class
Structure	0	92.0	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
Module thermal control	10	12,0	1	1/1	ı	1/1	1	1/1	1 .	1/1	1	1/1	1
Array drive	250	45,0	1	1/2 S	3	1/2 5	3	1/2 S	3	1/2 S	3	1/2 S	3
Array drive electronics	4537	30.0	1	1/2 \$	3	1/2 S	3	1/2 S	3	1/2 S	3	1/3 S	3
DIU/SCU	3464	22.0	1	1/1	2	1/1	2	1/1	2	1/2 S	2	1/3 S	2
Power conditioning	850	25.0	1	1, 2 S	3	1/2 S	3	1/2 S	3	1/2 S	3	1/3 S	3
Array	0	528.0	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
Harness	0	10.0	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
	Launch	-only weigh	it (1b)	19	4.6	19	4.6	19	4.6	. 19	9.0	20	8.0
Retrieval weight (1  Resupply weight (1)		val weight (1	ъ)	19	4.6	19	4.6	19	4.6	19	9.0	20	8.0
		ъ)	23	3.3	233.3		233.3		237.7		246.7		

 $C_o = $25.0K; k_1 = 1.28; k_2 = 1.11$ 

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Table 4-6. Electric Power Module Description

	in the second second				. 4	R	edundan	cy Conf	iguratio	ns			
Components				Mini	mum	Vari	ant l	Vari	ant 2	Non	ninal	Gro	wth
Name	λ(x10 <sup>9</sup> )	Cost (\$K)	Source	Red.	Class	Red.	Class	Red.	Class	Red.	Class	Red.	Class
Structure	0	19.6	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
Module thermal control	10	18.0	1	1/1	1	1/1	1	1/1	1	1/1	. 1	1/1	1
Power conditioning	2500	25.0	1	1/2 <b>S</b>	3	1/2 S	3	1/2 5	3	1/25	3	1/3 S	3
DIU/SCU	4580	39.0	1	1/1	1	1/1	<b>1</b>	1.2 S	1	1/25	1	1/2 S	1
Power control unit	800	65.0	] 1	1/2 S	3	1/25	3	1/2 S	. 3	1/2 S	3	1/2 S	3
Batteries	570	28.8	2	2/3 A	3	2/3 A	3	2/3 A	3	2/3 A	3	2/3 A	3
Harness	0	17.0	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
All and a second a	Launch	only weigh	t (lb)	404	. 6	404	1.6	416	.7	416	. 7	426	. 9
		al weight (l ly weight (l)		404 428		404 428	•	416 440		416 440		426 450	

 $C_0 = $30.0K; k_1 = 1.29; k_2 = 1.12$ 

#### 4.2.2 Payload

The two payload modules are defined in Tables 4-7 and 4-8 for two configurations, one more redundant than the other. Note that the video type recorders are included within the wideband communications and data handling module.

#### 4.2.3 Nonreplaceable Elements

Nonreplaceable elements are contained in a single NRU defined in Table 4-9.

#### 4.2.4 Spacecraft-Level Fixed Costs

Spacecraft-level fixed costs include such items as: program management; configuration management; system engineering; electrical design integration; mechanical design integration; reliability and safety; parts, materials and processes; quality assurance; integration; and environmental test. They enter into the total cost of a spacecraft (new or refurbished) as shown in equations (4) and (8). Values used during this study are:

- C<sub>So</sub> = \$0.496 M for launch-only and retrieval cases
- C<sub>So</sub> = \$0.645 M for resupply cases\*
- C<sub>Ro</sub> = \$1.50 M for retrieval cases
- C<sub>Ro</sub> = \$0.065 M for resupply cases.

For new satellites  $C_{So}$  has been arrived at with detailed cost analysis. The resupply value of  $C_{Ro}$  includes the costs of module handling during Shuttle payload insertion, etc. The retrieval value of  $C_{Ro}$  includes checkout and refurbishment of all spacecraft and payload modules to detect and eliminate contamination and damage caused by the Shuttle return environment.

<sup>\*</sup>Incremental \$150 K is added spacecraft cost to provide on-orbit servicing capability (actually part of the NRU, but included here as a convenience).

Table 4-7. Wideband Communications and Data Handling Module Description

			<u>.</u>	Pay	load Co	nfigura	tion
Compone	nts				A	В	
Name	Source	Red.	Class	Red.	Class		
High-speed multiplexer	76	3.7	1	1/1	1	1/1	1
Data processor	1475	72.0	1	1/1	1	1/2 S	1
Power amplifier	370	18.1	1	1/1	: 1	1/2 S	1
Antenna	104	5.1	1	1/1	1	1/1	1
Data channels	38	1.9	1	5/6 A	1	5/6 A	1
Video tape recorder	5500	400.0	2	1/2 S	1	1/3 S	1
,	Laun	ch-Only we	ight (lb)	24	0 ,	3 2	26
	Retri	eval weight	(lb)	24	0	32	26
	Resu	pply weight	(Ib)	3 2	29	41	. 5

 $C_0 = $30.0K ; k_1 = 1.29 ; k_2 = 1.12$ 

Table 4-8. Five-band MSS Module Description

_			_	Pay	load Co	nfigura	tion
Co	mponents				A	]	3
Name	λ(x10 <sup>9</sup> )	Cost (\$K)	Source	Red.	Class	Red.	Class
Multiplexer, etc.	4810	712.0	2	1/1	1	1/2 S	1
Band l channels	757	111.0	2	4/6 A	1	4/6 A	1
Band 2 channels	757	111.0	2	4/6 A	. 1	4/6 A	1
Band 3 channels	757	111.0	2	4/6 A	1	4/6 A	1
Band 4 channels	757	111.0	2	4/6 A	1	4/6 A	1
Band 5	2172	324.0	2	1/1	1	1/1	1
	Laun	ch-Only wei	ght (lb)	21	0	23	2 .
	Retri	eval weight	(lb)	21	.0	23	2
•	Resupply weight (lb)						

 $C_0 = $30.0K$ ;  $k_1 = 1.29$ ;  $k_2 = 1.12$ 

Table 4-9. Nonreplaceable Elements (NRU's)

Components					Configuration	
Name	λ(x10 <sup>9</sup> )	Cost (\$K)	Source	Red.	Class	
Spacecraft structure	0	88.9	1	1/1	2	
Payload structure	0	287.0	1	1/1	1.	
Transition ring	0	7.6	1	1/1	2	
Adapter	0	25.2	1	1/1	1	
Bus mechanisms	0	16.1	1	1/1	2	
Spacecraft thermal control	0	118.0	1	1/1	1	
Payload thermal control	0	233.0	1	1/1	1 ,	
Spacecraft harness	0	10.0	1	1/1	2	
Payload harness	0 .	10.0	1	1/1	ı	
	Launcl	n-Only weig	ht (lb)	,5	06.1	
	Retrieval weight (1b)			5	06.1	
•	Resupply weight (lb)			5	93.9	

 $C_0 = $60.0K ; k_1 = 1.29 ; k_2 = 1.11$ 

<sup>\*</sup>Applies to all spacecraft and payload configurations

#### 5. SIMULATION RESULTS

Simulation results are presented in this section for each of the three Shuttle modes, as well as results for conventional launch vehicles. Note that each case shown represents 100 Monte Carlo mission simulations. These results are evaluated in Section 6.

#### 5.1 SHUTTLE LAUNCH-ONLY MODE (EXPENDABLE)

Simulation data for use of the Shuttle in the expendable mode are presented in Table 5-1 for six satellite designs (spacecraft-payload combinations) and two values of Shuttle launch delay time.

This data, based on satellite failures prior to replacement, can be used to estimate the mean-time-to-failure (MTTF) of each design:

$$MTTF = \frac{T}{N-1} - D \tag{11}$$

where T is the mission duration (120 mos), N is the total number of launches (one being the initial launch), and D is the launch delay.

Table 5-2 shows the results of such computations for each of the six satellite configurations simulated, showing good agreement with analyses of similar configurations undertaken early in the study.

#### 5.2 CONVENTIONAL LAUNCH VEHICLE (EXPENDABLE)

Data for system maintenance via a conventional launch vehicle can be developed from Table 5-1 by noting that the number of flights will be unaffected by the launch vehicle used if all other factors are unchanged. \* Such results are presented in Table 5-3 for an assumed launch cost of \$5.5 million; of course, the data can be adjusted to consider any appropriate launch vehicle.

<sup>\*</sup>There are some other differences (e.g., in the actuation module); however, these have a relatively minor effect on the outcome.

Table 5-1. Results for Shuttle Launch-Only System Maintenance (10 Year Mission)

Satellite* Design	Launch Delay (months)	Percent Availability	No. of Flights	Cost/Satellite (\$M)	Cost/Launch (\$M)	Total Cost (\$M)
MIN-A	3	75. 1	10.84	11.04	1.443	135.3
VAR1-A	3	87.4	5.95	11.46	1.470	76.9
VAR2-A	3	90.7	4.66	11.73	1.482	61.6
NOM-A	3	93.9	3.41	12. 13	1.496	46.5
NOM-B	3 .	95.3	2.87	13.49	1.537	43.1
GRO-B	3	96.0	2.54	14. 22	1.568	40.1
MIN-A	1	89.5	13.49	11.04	1.443	168.4
VAR1-A	1	95.3	6.60	11.46	1.470	85.3
VAR2-A	1	96.5	5.13	11.73	1.482	67.8
NOM-A	. 1	97.9	3, 49	12. 13	1.496	47.6
NOM-B	1	98.3	3.06	13.48	1,537	46.0
GRO-B	· 1	98.8	2.48	14.22	1.568	39.2
•	•		÷		:	

<sup>\*</sup>For example, NOM-A is the nominal spacecraft design in combination with the A payload configuration (see Section 4).

Table 5-2. Effective MTTF from Launch-Only Simulation Data

Satellite Design	Launch Delay (months)	No. of Flights	MTTF (months)	Average MTTF (months)
MIN-A	3	10.84	9.2	8.9
MIN-A	1	13.49	8.6	0, 7
VAR1-A	3	5.95	21.2)	20.0
VAR1-A	1	6.60	20.4	20.8
VAR2-A	3	4.66	29.8)	20.0
VAR2-A	· <b>1</b> · · ·	5. 13	28. 1	28.9
NOM-A	3	3.41	46.8)	45.0
NOM-A	1	3.49	47.2	<b>47.</b> 0
NOM-B	3	2.87	61.2)	<b>50.0</b>
NOM-B	,1	3.06	57.3)	59,3
GRO-B	3	2.54	74.9)	
GRO-B	1	2, 48	80. 1	<b>77.</b> 5

#### 5.3 SHUTTLE LAUNCH-AND-RESUPPLY MODE

Simulation results for the resupply maintenance mode are presented in Table 5-4 for the baseline servicing logic, which schedules a Shuttle flight when a failure causes State 6 to occur (or States 7, 8, or 9). Table 5-5 shows equivalent data for the option of not servicing bases on State 6.

#### 5.4 SHUTTLE LAUNCH-AND-RETRIEVAL MODE

Data for retrieval maintenance has been derived from the resupply simulation data summarized above. Because the simulated resupply

Table 5-3. Results for Conventional Launch Vehicle System Maintenance (10 Year Mission)

Satellite Design	Launch Delay (months)	Percent Availability	No. of Flights	Cost/Satellite (\$M)	Cost/Launch (\$M)	Total Cost (\$M)
MIN-A	3	75.1	10.84	11.04	5.5	179.3
VAR I-A	3	87.4	5.95	11.46	5.5	100.9
VAR2-A	3	90.7	4.66	11.73	5.5	80.3
NOM-A	3	93.9	3.41	12. 13	5.5	60.1
NOM-B	3	95.3	2.87	13.49	5.5	54.5
GRO-B	3	96. 1	2.54	14. 22	5.5	50.1
MIN-A	1	89.5	13.49	11.04	5.5	223. 1
VAR1-A	Í	95.3	6.60	11.46	5,5	111.9
VAR2-A	1	96.5	5.13	11.73	5.5	88.4
NOM-A	1	97. 9	3.49	12. 13	5.5	61.5
NOM-B	1	98. 3	3.06	13.48	5.5	58. 1
GRO-B	1	98.8	2.48	14.22	5.5	48.9

Table 5-4. Results for Shuttle Launch-and-Resupply Mode with Baseline Flight Criteria: Serviced on State 6 (10 Year Mission)

0 4 114 7 1 1 1 1 1		<b>.</b>	No. of Flights			
Satellite Design	Launch Delay (months)	Percent Availability	High	Low	Total	Total Cost (\$M)
MIN-A	3	72.8	7.76	5.88	13.64	57.79
VAR1-A	3	89.9	2.55	9.24	11.79	41.34
VAR2-A	3	94.5	1.00	9.95	10.95	34.99
NOM-A	3	96.8	0.12	8.32	8.44	28.94
NOM-B	3	97.8	0.07	8.27	8.34	30.35
GRO-B	3	98.0	0.08	3.17	3.25	22.40
MIN-A	1	89.3	9.14	6.29	15.43	63.98
VAR1-A	1	96.3	2.88	9.69	12.57	42.87
VAR2-A	1	98.0	1.18	11.35	12.53	37.87
NOM-A	1	98.9	0.11	8.66	8.77	29.72
NOM-B	1	99.2	0.09	8.78	8.87	31.02
GRO-B	1	99.3	0.11	3.46	3.57	23.07

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Table 5-5. Results for Shuttle Launch-and-Resupply Mode with Alternate Flight Criteria: Not Serviced on State 6 (10 Year Mission)

			N	o. of Fligh	nts	
Satellite Design	Launch Delay (months)	Percent Availability	High	Low	Total	Total Cost (\$M
MIN-A	3	72.8	7.76	5.88	13.64	57.79
VAR 1-A	3	86.0	3.85	4.01	7.86	39.46
VAR2-A	3	89.5	2.96	3.45	6.41	34.70
NOM-A	3.	94.2	0.71	3.84	4.55	24.77
NOM-B	3	95.6	0.84	2.90	3.74	25.13
GRO-B	3	96.6	0.66	1.96	2.62	23.83
MIN-A	. 1	89.3	9.14	6.29	15.43	63.98
VAR 1-A	1	94.9	4.42	3.97	8.39	42.11
VAR2-A	1	96.6	2.84	3.37	6.21	33.31
NOM-A	1	98.0	0.79	3.97	4.76	25.69
NOM-B	. 1	98.4	0.91	2.97	3.88	. 26.07
GRO-B	1	98.8	0.59	2.15	2.74	23.57

philosophy replaces any modules in which there has been any component failure, the reliability of the satellite is restored to unity on each flight, equivalent to that of the new satellite which would replace a retrieved one. Thus, the flight statistics for retrieval will be the same as those for resupply, allowing computation of expected mission cost based on:

- The cost of launches from the Shuttle launch cost equation (Section 3.2.2.1) and data base (Section 4.1), used in combination with the satellite weights (from Section 4.2.1 data) and the high/low launch statistics (Tables 5-4 and 5-5).
- The cost of new satellites (the initial one and those required to replace any which are lost), based on the cost data of Section 4.2.1.
- The cost of satellite rework which can be derived from the resupply rework costs by noting the number of service flights made and adjusting for the difference in C<sub>RO</sub> (Section 4.2.4).

Tables 5-6 and 5-7 show the derived retrieval mission cost data for the two service flight criteria considered.\* Table 5-8 presents the cost details for the two Shuttle servicing modes.

The mission simulation presently schedules retrieval flights based only on loss of a component group in a nonreplaceable unit (NRU). Thus, only terminal failure cases can be simulated (by making all modules NRU's). Incorporation of more sophisticated retrieval logic is under consideration as a future development.

2-8

Table 5-6. Results for Shuttle Launch-and-Retrieval Mode with Baseline Flight Criteria: Serviced on State 6 (10 Year Mission)

			N	o. of Flight	:s	
Satellite Design	Launch Delay (months)	Percent Availability	High	Low	Total	Total Cost (\$M)
MIN-A	3	72.8	7.76	5.88	13.64	94.64
VAR 1-A	. 3	89.9	2.55	9.24	11.79	63.25
VAR2-A	3	94.5	1.00	9.95	10.95	52.65
NOM-A	3	96.8	0.12	8.32	8.44	40.27
NOM-B	3	97.8	0.07	8.27	8.34	41.78
GRO-B	3	98.0	0.08	3.17	3.25	25.45
MIN-A	. 1	89.3	9.14	6.29	<b>15.</b> 43	106.76
VAR 1-A	1	96.3	2.88	9.69	12.57	66.95
VAR2-A	1	98.0	1.18	11.35	12.53	58.65
NOM-A	1	98.9	Ö.11	8.66	8.77	41.57
NOM-B	· 1	99.2	0.09	8.78	8.87	43.59
GRO-B	1	99.3	0.11	3.46	3.57	26.68

Table 5-7. Results for Shuttle Launch-and-Retrieval Mode with Alternate Flight Criterion: No Service on State 6

44.			No	o. of Flight	ts	•
ellite sign	Launch Delay (months)	Percent Availability	High	Low	Total	Total Cost (\$M)
N-A	3	72.8	7.76	5.88	13.64	94.64
R1-A	3	86.0	3.85	4.01	7.86	57.34
R2-A	3	89.5	2.96	3.45	6.41	48.29
M-A	3	94.2	0.71	3.84	4.55	30.72
M-B	. 3	95.6	0.84	2.90	3.74	30.21
O-B	3	96.6	0.66	1.96	2.62	28.28
N-A	1	89.3	9.14	6.29	15.43	106.76
R1~A	i	94.9	4.42	3.97	8.39	61.74
R2-A	1	96.6	2.84	3.37	6.21	46.58
M-A	1	98.0	0.79	3.97	4.76	31.94
M-B	1	98.4	0,91	2.97	3.88	31.25
.O-B	1	98.8	0.59	2.15	2.74	26.30

Table 5-8. Resupply Simulation Data and Derived Retrieval Data

			) }	Numbe	er of Lau	nches		Resuppl	y Costs	İ		Retries	al Costs	
Service Criterion	Launch Delay	Satellite Design	Percent Avail.	High	Low	Total	Launch	Sat. Equip.	SRU Rework	Total	Launch	Sat. Equip.	SRU Rework	Total
Baseline:	3 mos	MIN-A	72, 8	7.76	5.88	13.64	43.46	11.74	2.59	57.79	62.39	11.59	20,66	94.6
States		VARI-A	89.9	2.55	9.24	11.79	26.85	12.08	2.41	41.34	33.48	11.93	17.84	63.2
6		VAR2-A	94.5	1.00	9.95	10.95	20.70	12.00	2.29	34.99	24.25	11.85	16.55	52.
7		NOM-A	96.8	0.12	8, 32	8.44	14.60	12.28	2.06	28.94	15.40	12.13	12.74	40.
8		NOM-B	97.8	0.07	8.27	8.34	14.27	13.90	2.18	30.35	15.35	13,75	12.68	41,
9		GRO-B	98.0	0.08	3.17	3.25	6,34	14.51	1,55	22.40	6, 33	14.36	4.76	25.
i	1 mo	MIN-A	89.3	9, 14	6.29	15.43	50.21	11.19	2,58	63.98	72.43	11.04	23.29	106.
	1	VARI-A	96.3	2.88	9.69	12.57	28.91	11.61	2.35	42.87	36.54	11.46	18.95	66.
		VAR2-A	98,0	1.18	11.35	12,53	23.53	11.88	2.43	37.87	27.94	11.73	18.98	58.
	] ]	NOM-A	98.9	0.11	8.66	8.77	15.07	12.52	2.13	29.72	15.95	12, 37	13.25	41.
		NOM-B	99.2	0.09	8.78	8,87	15, 18	13.63	2.21	31.02	16.41	13.48	13.50	43.
		GRO-B	99.3	0.11	3.46	3.57	7. 02	14.37	1.68	23.07	7.09	14, 22	5.37	26.
Alternate:	3 mos	MIN-A	72.8	7.76	5, 88	13,64	43.46	11.74	2,59	57.79	62.39	11.59	20.66	94.
	I	VARI-A	86.0	3.85	4,01	7.86	25.14	12.08	2,24	39.46	33,38	11.93	12.03	57.
States		VARI-A	89.5	2.96	3,45	6.41	20,49	12.23	1.98	34.70	26,51	12.08	9.70	48
7		NOM-A	94.2	0.71	3.84	4.55	10.63	12.40	1.74	24.77	11,65	12,25	6.82	30
8		NOM-A	95.6	0.84	2.90	3.74	9.87	13, 63	1,63	25, 13	11.17	13,48	5.56	30
9	1 1	GRO-B	96.6	0.66	1.96	2.62	8.06	14.37	1.40	23.83	8.34	14,22	3.72	28
	1 mo	MIN-A	89.3	9.14	6.29	15, 43	50.21	11.19	2,58	63,98	72.43	11.04	23.29	106
	1 mo	VARI-A	94.9	4.42	3.97	8.39	28.03	11.93	2,15	42.11	37, 25	11.78	12.71	61
		VAR1-A	96.6	2.84	3.37	6,21	19.59	11.88	1.84	33.31	25.53	11,73	9, 32	46
		NOM-A	98.0	0.79	3.97	4.76	11.42	12.40	1.87	25.69	12.44	12.25	7.25	31
Ì	) j	NOM-A	98.4	0.91	2.97	3.88	10.60	13.77	1.70	26.07	11.81	13.62	5.82	31
		GRO-B	98.8	0.59	2. 15	2.74	7.81	14.37	1.39	23,57	8.19	14.22	3.89	26

# 6. CONCLUSIONS AND RECOMMENDATIONS

## 6.1 EVALUATION OF RESULTS

Table 6-1 summarizes the mission cost data for all cases presented in the preceding section. These results are approximated graphically by the fitted-curves shown in Figure 6-1, where the correspondence between MTTF and satellite design is given in Table 5-2.

The other mission parameter of interest is the system availability (that is, the percentage of mission time during which the system is operational). Figure 6-2 shows availability for one data set (3-month launch delay) as a function of satellite design as characterized by MTTF.

This summary data leads to several fundamental conclusions:

- a) Reduced mission cost and increased availability can be gained by increased levels of satellite redundancy, so long as the increase in MTTF does not produce a marked increase in satellite hardware cost.
- b) Shuttle servicing provides significant advantages (reduced cost, increased availability) over an expendable system maintenance approach.
- c) For expendable operation, Shuttle launch is much less expensive than use of a (low cost) conventional launch vehicle.
- d) For the particular service policies considered, the resupply mode of Shuttle use is more cost effective than retrieval and provides the same levels of availability.
- e) The alternate servicing logic is generally less expensive than the baseline servicing logic, but provides lower availability.
- f) A decrease in the Shuttle launch delay will increase availability, but with an accompanying increase in mission costs.

The dependence of these conclusions upon the simulation models and data base employed should be stressed. The following paragraph considers each of the above conclusions from this and other points of view.

Table 6-1. Summary of Cost Data for 10 Year Mission

		Total Mission Costs (\$M)												
,		Expendab	le	Res	upply	Retr	ieval							
Launch Delay (months)	Satellite Design	Conventional Launch Vehicle	Shuttle Launch	Baseline Service	Alternate Service	Baseline Service	Alternate Service							
3	MIN-A	179.3	135.3	57.8	57.8	94.6	94.6							
3	VAR1-A	100.9	76.9	41.3	39.5	63.3	57.3							
3	VAR2-A	80.3	61.6	35.0	34.7	52.7	48.3							
3	NOM-A	60. 1	46.5	28.9	24.8	40.3	30.7							
3	NOM-B	54.5	43.1	30.4	25.1	41.8	30.2							
3	GRO-B	50.1	40.1	22.4	23.8	25.5	28.3							
1	MIN-A	223. 1	168.4	64.0	64.0	106.8	106.8							
1	VAR 1-A	111.9	85.3	42.9	42.1	67.0	61.7							
1	VAR2-A	88.4	67.8	37.9	33.3	58.7	46.6							
1	NOM-A	61.5	47.6	29.7	25.7	41.6	31.9							
1	NOM-B	58. 1	46.0	31.0	26.1	43.6	31.3							
1	GRO-B	48.9	39.2	23.1	23.6	26.7	26.3							

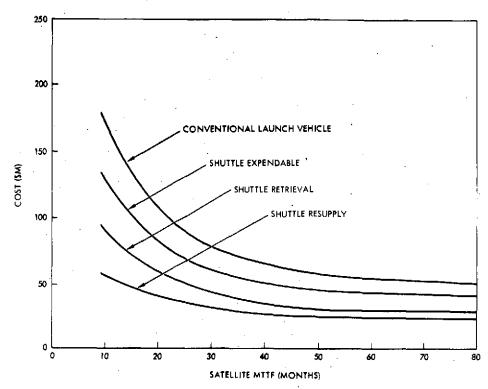


Figure 6-1. Mission Costs with 3-Month Launch Delay (10-Year Missions)

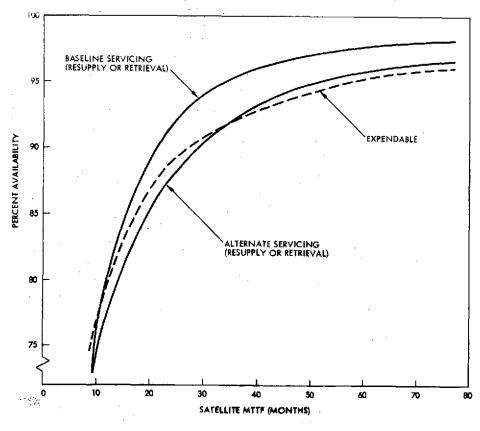


Figure 6-2. System Availability with 3-Month Launch Delay

# 6.1.1 Effect of Satellite Redundancy

As demonstrated conclusively by the results for all system maintenance modes, increasing spacecraft redundancy at the black-box level can have a salutary effect upon both total mission costs and system availability. This trend occurs because relatively large MTTF increases are attained via relatively small increases in satellite cost, thus decreasing the number of launches required.

Figure 6-3 shows this trend in satellite costs, based on data presented in Tables 5-1 and 5-2. The one "bump" in the otherwise smooth curve is due to the NOM-B (nominal spacecraft with payload B) configuration. This discontinuity manifests itself in the detailed resupply/retrieval mission cost data (Table 6-1) by a similar phenomenon: in the nonexpendable cases there is a consistent increase in mission cost from NOM-A to NOM-B even though the average number of launches never increases.

This result shows the effect of a significant satellite hardware cost increase without a consistent increase in satellite life. In this case the cost increase is probably in error due to the modeling of the payload elements; in other instances (e.g., increase in spacecraft redundancy beyond the growth configuration) this same situation can occur.\*

The fact that large increases in satellite MTTF can be achieved at low cost is not surprising, considering the complexity of the basic space-craft. However, further increases will cost more, suggesting an eventual upturn in mission cost vs. MTTF curves.

The question of design life must also be considered. The mission simulation as now programmed is unable to treat degradation, a factor

<sup>\*</sup>Cost data to the level of the redundancy blocks was unavailable for the payload elements. The total cost of the basic designs was, therefore, spread in proportion to the block failure bits (Tables 4-7 and 4-8). The costs of the redundant configuration were then computed on the basis of these block costs and are probably excessive.

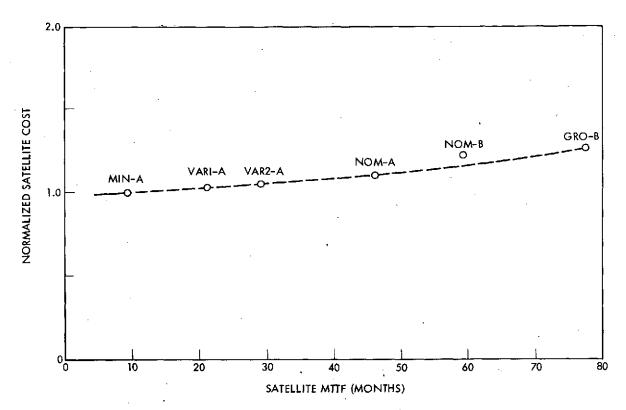


Figure 6-3. Normalized Satellite Cost as a Function of MTTF for Expendable Shuttle Launch

of significance with solar array cells, batteries, etc. For life-limited designs the mean-mission-duration (MMD) is a good measure of satellite life:

$$MMD(T) = \int_0^T R(t) dt$$
 (12)

where T is the design life and R(t) is the satellite reliability. Note that MMD is always less than the design life, asymptotically approaching T as redundancy is increased. On the other hand, MTTF = MMD( $\infty$ ) and is not similarly constrained. In terms of MMD, increases in redundancy without a design life improvement could be wasteful. Again, an increase in mission cost would result, since satellite cost increases would not be accompanied by a marked decrease in launch frequency and cost. For

this study, simulation results with MTTF above 3 or 4 years are probably not representative, unless all elements (e.g., solar array, batteries) have design lives on the order of 5 to 10 years.\*

## 6.1.2 Effect of Satellite Maintenance

Satellite maintenance using Shuttle retrieval or resupply offers conclusive advantages over the expendable alternatives (Figure 6-1). Availability is improved because some service flights are made in order to prevent loss of the satellite (an abort capability), prior to loss of operational status.

Mission costs are decreased by reuse of satellite hardware as can be seen from Table 6-2, which shows the total launch costs for each approach to system maintenance. Launch costs are higher with Shuttle resupply or retrieval than in the expendable Shuttle application mode, due partly to the somewhat larger number of flights but mainly due to the absence of high-altitude expendable launches (which, according to the selected cost algorithm are almost 4 times more expensive than low altitude flights). These increased launch costs are more than offset by savings in satellite equipment, as evidenced by the total mission costs.

### 6.1.3 Effect of Conventional Launch Vehicle

For an expendable system maintenance philosophy, Shuttle launch to low altitude (with subsequent orbit transfer using spacecraft propulsion) is more cost effective than direct injection using a Thor-Delta 2910 launch vehicle. This lower cost-per-launch is a direct function of the Shuttle costing algorithm, which assumes that the payload capability not used by EOS can be used by other missions. If EOS had to pay the total cost of dedicated Shuttle launches, this conclusion would no longer be true. Here, as in other areas, the conclusions are determined largely by the Shuttle costing model.

<sup>\*</sup>At high levels of redundancy flights are becoming so infrequent that additional flights may have to be scheduled to update payloads. If these factors are included, highest redundancy may not yield the most cost effective approach.

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Table 6-2. Summary of Launch Cost Data for 10 Year Mission

** ** ********************************		· .	То	tal Launch	Costs (\$M)		·
		Expendab	le	Res	upply	Retr	ieval
Launch Delay (months)	Satellite Design	Conventional Launch Vehicle	Shuttle Launch	Baseline Service	Alternate Service	Baseline Service	Alternate Service
3	MIN-A	59.6	15.6	43.5	43.5	62.4	62.4
3	VAR 1-A	32.7	8.7	26.9	25.1	33.5	33.4
3	VAR2-A	25.6	6.9	20.7	20.5	24.3	26.5
3	NOM-A	18.8	5.1	14.6	10.6	15.4	11.7
3	NOM-B	15.8	4.4	14.3	9.9	15.4	11.2
3	GRO-B	14.0	4.0	6.3	8.1	6.3	8.3
l	MIN-A	74.2	19.5	50.2	50.2	_72.4	72.4
1	VAR1-A	36.3	9.7	28.9	28.0	36.5	37.3
1	VAR2-A	28.2	7.6	23.5	19.6	27.9	25.5
1	NOM-A	19.2	5.2	15.1	11.4	16.0	12.4
1	NOM-B	16.8	4.7	15.2	10.6	16.4	11.8
1	GRO-B	13.6	3.9	7.0	7.8	7.1	8.2

## 6. 1. 4 Effect of Retrieval vs. Resupply

The simulation data shows a consistent advantage for resupply (on-orbit module replacement) when compared with retrieval (ground refurbishment). These differences occur in the launch costs (lower because the average payload weight is lower) and in the equipment rework costs (which for retrieval include detecting and correcting problems introduced in all modules due to the Shuttle return flight environment). The launch cost differences are particularly sensitive to the FSS and SPMS weights, and emphasize the desirability of lightweight implementation of these mechanisms. As before, the Shuttle costing model plays a key role in determining mission costs.

## 6.1.5 Effect of Servicing Policy

For both resupply and retrieval two servicing policies were evaluated. The baseline scheme anticipates loss of deboost capability by servicing when a failure causes any Class 2 group to become one failure away from loss. The alternate logic, like the baseline, services on:

- loss of any Class 1 group,
- loss of any Class 2 group,
- one-away from loss of any Class 3 group,

but does not anticipate loss of deboost capability.

The results show the alternate policy more cost effective in all cases except those with the GRO-B satellite design. In most cases the baseline logic results in considerably more Shuttle flights, without a compensating decrease in the number of high altitude flights. With the GRO-B design, in which a number of Class 2 and Class 3 groups are made triple-redundant, the number of Shuttle flights with the baseline logic is less than half its value with any other design; there are in this case few opportunities for a Class 2 group to be one failure away from loss.

Although generally more cost effective, the alternate logic does lead to more system down time (Figure 6-2), because a higher percentage of flights occur after the satellite has gone down. There is, therefore, a cost-availability tradeoff to be considered.

## 6.1.6 Effect of Launch Delay

Decreasing the elapsed time between a flight decision and occurrence of the flight has the expected effect of increasing availability and cost. However, the actual cost increase is probably much greater than the increment shown, because the schedule-related cost increases in reducing turnaround from 3 months to 1 month are not included.

#### 6.2 RECOMMENDATIONS FOR FUTURE STUDIES

The results of this study have led to some interesting conclusions as discussed in the preceding section. Some of these conclusions are simulation model and data dependent as noted above. Further mission tradeoff studies, exploring those issues and others, are suggested, including the following:

- Shuttle Cost Model. The above conclusions appear to depend strongly upon the model used to charge the EOS program for use of the Shuttle. With this in mind, the model should be reviewed and perhaps revised. Future studies could include any new Shuttle cost model suggested by GSFC.
- Design Life Simulation. Realistic inclusion of time-related component degradation is desirable, particularly if highly redundant designs are to be considered. The model of degradation must consider several levels of performance, analogous to the component group classes now used, because exceeding the design life of an array (for example) will not prevent deboost or cause loss of the satellite.
- Redundancy Studies. Studies thus far suggest that increases of above the GRO-B configuration may penalize mission cost. Definition and study of such designs is suggested, but must be accompanied by a realistic design life model and instrument upgrading policies.
- Payload Cost Data. As noted earlier, sufficiently detailed payload cost data was unavailable for this study. Development and inclusion of more definitive data is suggested. In this context alternate payload sensors (TM, HRPI) can be modeled and evaluated.
- Alternate Missions. This study has considered a single-satellite/single-instrument system. Future studies should deal with realistic alternatives (e.g., multiple satellite or a single-satellite with tandem sensors), considering an availability model which accounts for degraded operation (e.g., one of two sensors operating).

• Inventory Effects. The selected mission simulation model has assumed a fixed delay between launch decision and flight. In fact, the delay will depend on a variety of factors, including module inventory. Advanced studies can evaluate the effect of module inventory limitations on total mission costs.

### 7. REFERENCES

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- 2. SAMSO TR74-168, "In-Space Servicing of a DSP Satellite," Vols. 1, 2 and 3, March 1974
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## APPENDIX A

SIMULATION MODEL AND COMPUTER PROGRAM

#### APPENDIX A

### SIMULATION MODEL AND COMPUTER PROGRAM

#### 1. INTRODUCTION

The economic assessment of the launch, retrieval, and resupply modes of servicing the EOS with the Space Transportation System (STS) is made using results derived from a computer simulation model of satellite deployment, in-space refurbishment and servicing, and retrieval and ground refurbishment.

The basis for the computer simulation is the satellite mission life cycle cost simulation model. This general simulation model and its implementation using a computer have been under development by TRW for approximately two years. The model is generally sufficient to handle the economic analysis of the EOS satellite; however, this study did necessitate the inclusion of EOS-specific cost and space servicing details.

The satellite mission life cycle cost simulation model, Figure A-1, shows the essential operations or activities encountered in deploying and maintaining a satellite or constellation of satellites in orbit for the life of the mission. The activities encompass all those operations required for on-the-ground support, Space Shuttle launch, in-space operation, service launch decisions, in-space servicing, and retrieval and ground refurbishment. Monte Carlo techniques are used with statistical representations of each important parameter.

An "activity" is a function (designated by a box in Figure A-1) which receives an input, performs a transformation on that input, and produces an output. For example, a packet of information in the form of an order enters satellite equipment manufacturing (Activity 44, Figure A-1) and at some time later an output, which is a grouping of space replaceable unit(s) (SRU's), leaves the activity. The activities shown in the model are all interconnected with arrows that represent the inputs and outputs. A solid arrow represents the flow of hardware (i.e., Space Shuttle, satellite, group of SRU's, or one SRU) and a dotted arrow represents the flow of information (e.g., flight order, failure order, or hardware order).

As the hardware and orders flow through the activities, the time is advanced according to the time (in hours) assigned to perform an activity. For example, suppose a payload installation into a Shuttle at A-19, takes 169.6 hours; therefore, if the Shuttle was available when a satellite entered at 8765.4 hours, the Shuttle would move into A-24 at 8935.0 hours. The time required to perform an activity is chosen by drawing a random number, entering the distribution describing the time variation and picking the actual time for that specific operation. The movements of the hardware and orders take place as they complete activities; i.e., between 8765.4 hours and 8935.0 hours there may be a component failure order leave A-65 at 8766.2 hours, a spacecraft may leave A-44 at 8830.9 hours and a Shuttle leave A-27 at 8921.6 hours.

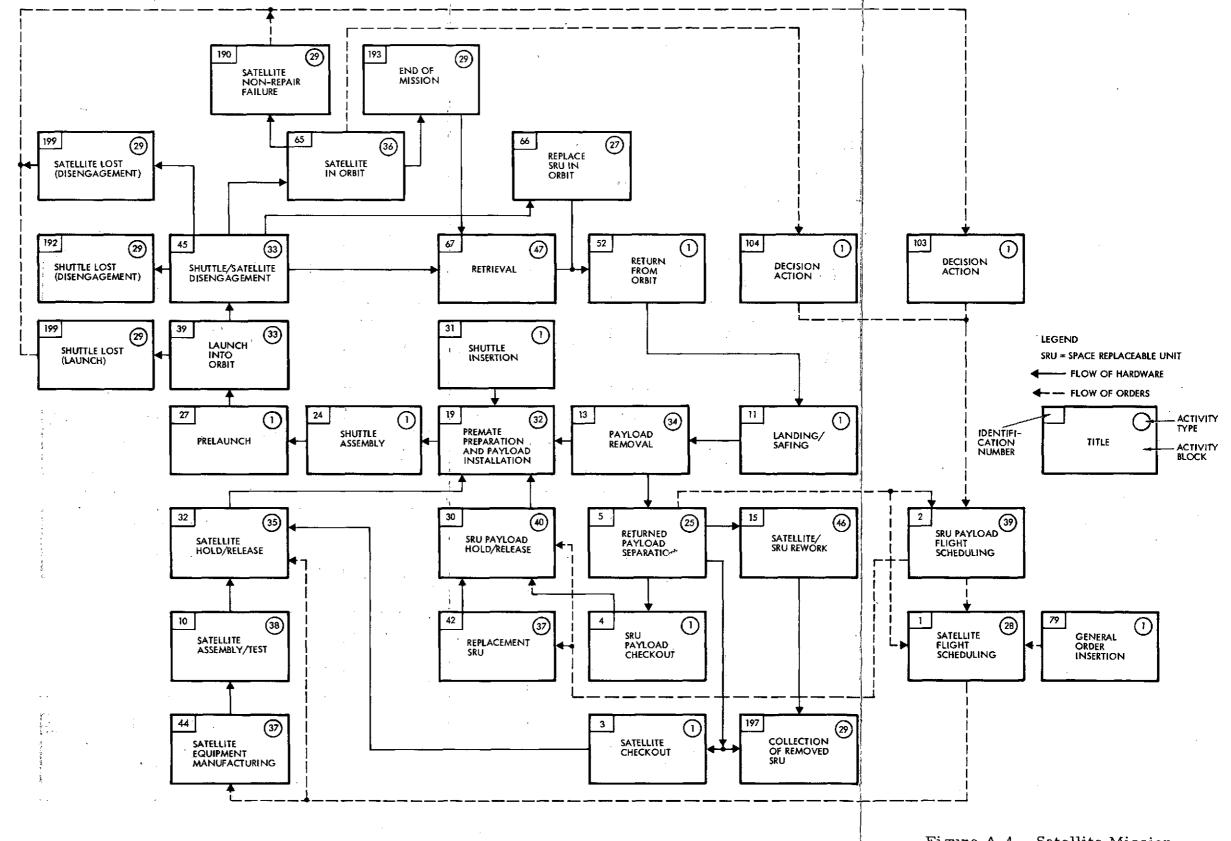
In addition to time advancement, program cost accumulation occurs as hardware and orders flow through cost-related activities (e.g., satel-lite equipment manufacturing, SRU rework, etc.). Costs are computed based upon the relevant general formulas and particular input values.

The activities represented in the model of Figure A-1 are considered a reasonable and practical representation of all the pertinent interfaces and decision criteria for the EOS study. A few minor improvements could not be included within the schedule and budget constraints of the study. However, the detail logic content of each activity is so constructed that the incorporation of foreseeable future model improvements would not require complete revision of the activity.

# 1.1 Simulation Model

In order to point out the primary features incorporated in the activities of the satellite mission life cycle cost simulation model, a detailed explanation of typical movements of hardware and orders is presented below. The model, Figure A-1, should be referred to at each transfer. In the explanation, A-number means an activity identified by that number, as shown in the square in the upper left corner of each activity block. The circled number in the upper right corner of each block is used by the computer for the selection of the proper logic.

At time 0, several actions are initiated in the model. First orders leave A-79, general order insertion, and enter A-1, Satellite flight



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Figure A-1. Satellite Mission Simulation Model

scheduling. Then Space Shuttle leaves A-31, shuttle insertion, and position themselves in A-19, premate preparation. Flight orders and launch orders which establish the number of satellites to be put in orbit and launched on a given flight, move from A-1, satellite flight scheduling, to A-32, satellite hold/release, and manufacturing orders, which initiate manufacture of the appropriate number of satellites, move from A-1 to A-44.

To simulate the satellite assembly and test process, the orders in A-44 begin a cycle to make available satellites according to a prescribed time schedule. A satellite section is defined as the SRU and nonreplaceable units (NRU) which comprise a complete satellite. Here the production cost of a satellite is computed based upon component costs, SRU-level costs, and multiplicative factors for buying and manufacturing. As the sections are available, they move into A-10, satellite assembly/test. In A-10 it is assumed that only one satellite can be assembled and tested at one time. The satellite moves into A-32, satellite hold/release, when it is finished in A-10.

The completed satellite joins with the flight order in A-32. When the appropriate number of satellites to be flown on a given launch (one for the EOS system) are available, the satellite(s)/flight order(s) join with the launch order, and are released into A-19, premate preparation and payload installation. A-32 will hold satellites and release them only when launch and flight orders are available, or will hold orders and release them only when a satellite enters. For example, if five satellites are assembled and are available at three month intervals, and four flight orders are ready at 0 time, then each of the first four satellites will move through A-32 into A-19 as it completes A-10. The fifth satellite will remain in A-32 until a satellite in orbit needs to be replaced; detection of a nonrepairable satellite initiates replacement flight and launch orders which joins up with the fifth satellite in A-32. Now, if a second satellite needs to be replaced, the flight and launch orders for its replacement would wait in A-32 until an additional satellite can be produced.

In A-19, premate preparation and payload installation, the satellite is joined to the Shuttle. In this activity, it is assumed that only one payload installation can take place at one time. The now-loaded Shuttle advances through A-24, Shuttle assembly, and A-27, prelaunch. Here

the costs associated with launching the satellite are accumulated. For the EOS, table of weight and cost values is input in order to make this calculation. For all cases (launch only, resupply, retrieval), cost is a function of weight carried up. The loaded Shuttle moves into A-39, launch into orbit, where it is subject to a possible random loss which is specified as a probability. The actual loss determination is made by a random number draw which is compared to the specified probability. If the Shuttle survives A-39, it moves into A-45, Shuttle/satellite disengagement. Here, too, the satellite is subject to possible random loss, as in A-39. At this point, the satellite is separated from the Shuttle upper stage (OOS) and they are modelled separately. The Shuttle moves through A-52, return from orbit, A-11, landing/safing, and A-13, payload removal. Finally, the Shuttle is refurbished (not included in this model) and returns to A-19 to await another payload.

The satellite leaves A-45, moves into A-65, satellite in orbit, and is put into active service. A satellite is comprised of a number of SRU's and NRU's, each of which is described by a reliability block diagram of series and/or redundant components (such as receivers, transmitters, batteries, earth sensors, etc.). These are turned on by selecting a random number and using the component's reliability description, failure rate ( $\lambda$ ), and a shape parameter ( $\beta$ ) to calculate a time to failure. All SRU's and NRU's component failure times are reviewed after these calculations and the failure time which is closest to present time is entered as the next event.

Each component is given a severity classification based upon the effect its failure would have on the satellite. As failures occur, redundant groups of components move into different failure "states," depending upon the component class. Servicing decisions are made based upon these satellite states.

The mission starts when a prescribed number of satellites comprising a constellation are all in orbit and operational. For example, if by the time the last satellite of the constellation is activated an earlier launched satellite has become inoperative, the mission has not started. The entire constellation must be operational simultaneously to commence the mission. Although all satellites are alike from the standpoint of hardware (SRU/NRU)

configuration, it is possible in the model to specify an operational difference for an individual satellite. In an extreme case, one satellite may have an SRU with all components turned on while another may have the same SRU with all components turned off.

Whenever the component failure time (i. e., next event) of a satellite in orbit arrives, the satellite is completely reevaluated to determine its operational status. There are two types of situations, an SRU component failure or an NRU failure, each of which will be explained below.

Every SRU component failure causes a failure order to be generated so that the details of this failure can be evaluated on the ground. The SRU which contains the defective component is evaluated for sufficient component redundancy. A standby component is turned on, if available. If this component failure causes the SRU to be inoperative, this is noted by a decrease in the number of operating satellites, i.e., change in satellite availability. All SRU's of the satellite are now searched in order to find the next expected component failure time (i.e., next event). A failure order leaves A-65 and moves into A-104, decision action. This activity, A-104, is inserted to allow a time delay for ground evaluation of the data (for this study the delay time is set to 0). The failure order moves into A-2, SRU payload flight scheduling, where the pertinent failure data is entered in a summary table. After each failure entry, all table entries are reviewed in order to determine whether a service flight is required. A space servicing flight is initiated in the EOS resupply case when the satellite is in one of the following states: 1) the failure of a component or SRU causes a satellite to be inoperative or, 2) one additional failure of a component in a redundant group would cause loss of the satellite, or, 3) either failure or one additional failure (depending upon which input option is chosen) of a component would prevent satellite boost/deboosting. If one of the aforementioned criteria is met, then a service flight order moves out of A-2 into A-42, replacement SRU, where the required payload SRU's are generated. After the SRU payload information is left in A-42, the order moves into A-30, SRU payload hold/release, to await replacement. When the proper SRU's for that service flight are accumulated in A-30, the SRU group combines with the failure order and the payload moves into A-19 to load into the Service OOS to go up on an available

Shuttle. The Shuttle/service OOS moves with its load as previously described for a satellite launch, except that it moves through A-45 without a time change and the load does not separate from the service OOS. The service OOS and SRU payload go into A-66, replace SRU in-orbit. The service OOS visits each satellite needing repair and all the new SRU's are put into the satellites and the old ones are brought aboard the Shuttle. When an exchange of SRU's is complete for a satellite, the new ones are activated, as previously described for a newly launched satellite, and the next new component failure time is determined. If the satellite was inoperative, it is now made operative. This is noted by an increase in the number of satellites operable.

Servicing flights for the EOS are made to either low altitude or high altitude depending upon the classification of a component group and how many units are failed. High-altitude servicing is performed in the event of failure of a Class 2 component group; otherwise, low-altitude servicing is performed.

The Shuttle with the old SRU's moves through A-52, A-11 and into A-13. However this time, since there is a returned payload, it is separated from the Shuttle. The Shuttle goes into A-19 to await another payload, and the returned payload moves into A-5, returned payload separation, where the failure order is separated from the old SRU's. The payload then moves to A-15, where costs of reworking the returned SRU's are accrued based upon their failed components. The returned payload then moves into A-197, collection of returned payloads, where a fixed SRU rework cost is accrued. The failure order goes into A-2, SRU payload flight scheduling, where it removes all entries pertaining to its replacement flight since the task is completed. The entries are left in the summary table so that in case an SRU replacement payload is lost it can be repeated.

An NRU failure in a satellite causes it to be inoperative; the satellite cannot be repaired by replacing a unit, therefore, a new satellite must be launched. A satellite which becomes inoperative due to an NRU failure moves out of A-65 into A-190, satellite nonrepair failure, and the number of operating satellites is decreased. The satellite remains in A-190; however, its flight order, which had previously joined with the

satellite in A-32, is now released. The flight order moves into A-103, decision action, the time delay for a ground decision (in this model it is set to 0). Next, the flight order goes into A-2, it examines the component failure summary table and removes all SRU entries which are related to the nonrepairable failed satellite. After this, the flight order moves into A-1, satellite flight scheduling, if there is a completed satellite ready (e.g., if only four were required for starting a mission but five were manufactured in the production run), then the flight order will go directly to A-32 and proceed as previously described.

If there is not a completed satellite ready, the flight order generates a hardware order which will start the production of a new satellite, as well as a launch order. The launch order moves to A-32. The hardware order moves into A-44 and starts the production cycle for the satellite sections. In this latter case, the flight order moves in A-32 to await the new satellite and proceed as previously described. Whenever the need for a new satellite comes so late in a mission that its orbital operating time would be too short, flight hardware order does not proceed any further than A-1.

If the retrieval option is chosen, a retrieval order is generated in A-1, and sent to A-32, where it mates with the appropriate launch order to retrieve the appropriate (failed) satellite. In A-45 the retrieval order, along with the Shuttle, separates from the newly launched satellite. Both Shuttle and retrieval order move into A-67, retrieval, where both mate with the failed satellite. The Shuttle and retrieval satellite are separated in A-5, and the satellite moves into A-15, satellite rework, where all its failed components are reworked. Costs are accumulated here based upon components reworked. The reworked satellite then moves into A-197, and eventually to A-32, where it waits for launch and flight orders.

In the case where a satellite is lost, as in A-199, satellite lost, the flight order is removed from the satellite and the order proceeds in the same manner as described for a satellite nonrepairable failure. Eventually the time advances to the end of the mission, at which time all operating satellites moved from A-65, satellite in-orbit, to A-193, end of mission.

### 2. COMPUTER PROGRAM

The simulation model computer program is a discrete event program, one in which items are processed through an activity with definite start and finish times. Time starts at 0 and increases from event to event until the mission is completed. The events are variable time incremented which means that the time of the next event is as it occurs, i. e., a series of events may occur at 10,531.6, 10,631.7, 10,632.8, 10,633.4, and 12,222.2 hours. As previously mentioned, both hardware and orders have substance; they are entities that move their activities.

No attempt will be made here to explain or show the computer program in its entirety. It is a 7000-card program composed of a main program and 51 subroutines. However, a simplified logic flow chart of the main program will give the essence of the program.

Figure A-2 shows a very simplified logic flow diagram of the main program. This flow chart depicts the movements of the computer through the instructions which manipulate the model. This is essentially a driver that calls subroutines as it moves from the start through the actions and decisions enough times in order to manipulate the model's hardware and orders until it reaches the end.

In summary, as each event is encountered a piece of hardware or order is moved from the activity it just finished into the next activity and it is rescheduled; the cycle is repeated until there is nothing else to move.

The following discussion covers each of the 10 numbered rectangles, parallelogram and diamonds of the logic flow chart, Figure A-3.

Input data and initial conditions. The input data to the program consists of activity descriptions, hardware/order descriptions, SRU/NRU unit descriptions, and timeline analysis. As the input data cards are read into the computer, some error checking is performed on the most expected keypunch and user data inconsistency errors. If an error or a contradiction in data is found, then a diagnostic message is printed. A set of activity description data cards contain information relating to connecting to its input and output activities, activity type and identification numbers, a list of descriptors, and the initial (0 time) status. The hardware/order descriptions establish the condition of all necessary initial (0 time) locations, scheduled event time, information relating to hook-up with other hardware or orders, and any queueing states. The SRU/NRU unit descriptions give the composition of the

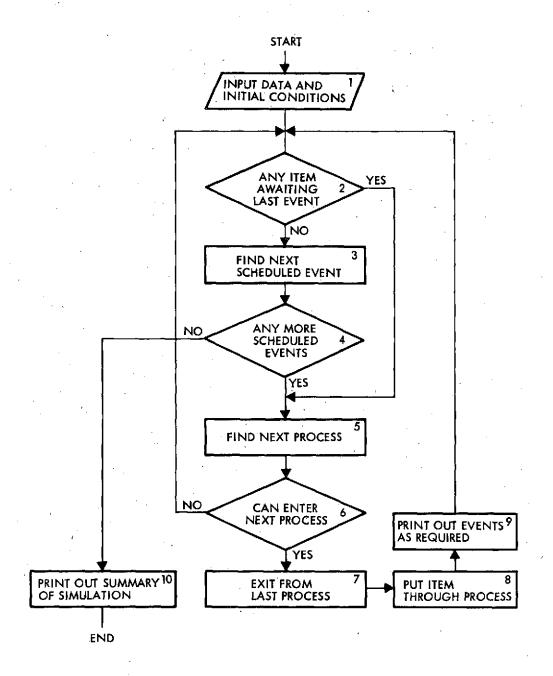


Figure A-2. Program Logic Flow

unit in terms of all its components, i. e., reliability block diagram, component reliability descriptors, and component cost.

As an aid to interpretation and review of the input data, a printout is made in a narrative form which shows what has been read into the computer. The inputted data does not contain narrative, it just contains numbers which described the data set. The input data format is shown in Figure A-3.

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Figure A-3. Standard Input Data Format - Satellite Mission Life Cycle Cost Simulation Model Computer Program

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Since the expected inputs can be extensive, attempts are made to keep the amount of computer memory used to a minimum. The various activity types are of different lengths in terms of computer words; therefore, it is most economical to store this in a packed fashion. For this reason, the location of a specific data must be accessed by formula within an activity. In order to get the quickest transfer from one activity to another, the input and output activity identification numbers are converted to relative computer locations and stored with the other activity descriptors. As an assist for the user, it is not necessary to numerically order the activity identification number within the input data card deck. During this input phase all the starting values are initialized.

- Any item awaiting last event? As the program starts manipulating the model, instances will occur in which the hardware order must wait for a future event whose time may not be predictable in advance. Therefore, the item must wait and any last event must be checked against waiting items to see if the event was the one which was being waited on. For example, the only Shuttle in A-19 (see Figure A-1) may be having a satellite put onboard and an SRU payload may be ready to go onboard a Shuttle. The SRU payload must wait until another Shuttle arrives or this Shuttle makes its round trip (if it happens to be the only one). The check for this type of situation is made here. Whenever the last event occurrence does not release a waiting item, the program goes for the next event. A released waiting item becomes the next event, thus by-passing 3) and 4).
- 3) Find next scheduled event. The time of the next event and the activity location at which it is located is found.
- 4) Any more scheduled events? When there are no more scheduled events the mission simulation will proceed to a finish, otherwise it continues.
- Find next process. The location of the next activity is found. This can be a single choice, such as the Shuttle going from A-19 to A-24. It can also be one of several paths, such as an order leaving A-2, in which case the correct path depends upon the characteristic (type of contained information) of the order. Another situation could be the move from A-39 where the Shuttle can go to A-45 to A-199, depending on the value of a random number.
- 6) Can enter next process? There are instances when the next activity cannot accept the item waiting to enter. This situation is discovered by interrogating the internal state of the next activity. In the Shuttle/payload example described in 2), the SRU payload gets into the await status through this processing. The SRU payload found only one Shuttle and that was being loaded, therefore, it went into an await so as to

let the next event come up. Eventually some future next event would be the one for which the SRU payload was waiting. If entry is unobstructed, the item moves on.

- 7) Exit from last process. Prior to the item leaving the current activity for the next activity, the status of the current activity must be reset to account for the leaving of the item.

  Thus, another item at a future next event will see the correct status of the activity when it interrogates as described in 6).
- 8) Put item through process. The next activity now becomes the current activity, the entering item is set into the activity and the proper transformation is made with a scheduled completion time.
- 9) Printout events as required. As events take place, any record of the details which have transpired are printed out or saved for future summarization. This completes the main loop of instructions.
- Printout summary of simulation. When the simulation is completed, the results which best describe the happenings are printed. A concise selection of the most descriptive data is outputted, because data from the total number of events are great in volume and unwieldy to interpret. (See Figure A-4.)

The simplified logic flow chart depicts a single simulation of a mission. The simulation is a (dynamic) Monte Carlo type; therefore, to observe the variations in the measured parameters of the mission system many simulations are made. The logic flow chart would be modified for many simulations by looping up to initial conditions instead of printing out a summary. This printout would be made after a significant number of simulations. In this case, the essential events (see 9)) for only one mission are printed out, since a printout for many missions would be huge (several hundred pages).

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Figure A-4. Standard Output Data Format - Satellite Mission Life Cycle Cost Simulation Model Computer Program

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Figure A-4. Standard Output Data Format — Satellite Mission Life Cycle Cost Simulation Model Computer Program (Continued)

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\*\*\* MISSION COST (MILLIONS) \*\*\*

COST DLR 20

Figure A-4. Standard Output Data Format - Satellite Mission Life Cycle Cost Simulation Model Computer Program (Continued)

ORIGINAL PAGE IS OF POOR QUALITY

# APPENDIX B

REPRESENTATIVE MISSION SIMULATION FOR LAUNCH-ONLY SHUTTLE MODE

DATE: 09/12/74.

RUN DESCRIPTION: EOS - LAUNCH ONLY, NOMINAL, PAYLOAD A, 1 FO. CELAY

NUMBER OF SIMULATIONS: 100

FAILURE RATE K FACTOR: 1.000 (INCLUDED IN PRINTED MTBF VALUES)

10 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.

```
PROCESS 1 *** SATELLITE FLIGHT SCHEDULING
  IT IS LOCATED AT POSITION 167 OF THE INTERNAL COMPUTER LIST AREA.
 PRICESS TRANSFORMATION TYPE 28 HAS 21 DESCRIPTORS.
       1.00, 1.00, 0.00, 730.00, 1.00, 1.00, 0.00, 14.00, 0.00, *99999.00, *99999.00, 0.00, 0.00, 0.00, 0.00,
                                                                                       0.00.
                                                                                      1.00,
       1.00, 0.00,
                           0.00.
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 3 INPUT PROCESSES ARE 5, 2, 79,
 THE 3 CUTFUT PROCESSES ARE 32, -1, 44,
   CUTPLT SCHEME 15 IS USED
 *O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
PROCESS 2 *** SRU PEPLACEMENT SCHEDULING ***
  IT IS LOCATED AT POSITION 72 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 39 HAS 11 DESCRIPTORS.
       58.0C, 0.0U, 0.00, *99999.00, *99999.00, *99999.00, *99999.00, *99999.00,
                  0.00 -
        4.00.
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 3 INPUT PROCESSES ARE 104, 103, 42,
 THE 3 CUTPUT PROCESSES ARE 42, 30, 1,
 *O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE G ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
PROCESS 3 *** SATELLITE CHECKUUT
  IT IS LOCATED AT POSITION 366 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS.
               72.00
                           0.00, 0.00,
        1.00.
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1. INPUT PROCESSES ARE 5.
 THE 1 CUT FUT PROCESSES ARE 32,
  CUTPUT SCHEME O IS LSFD
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INITIALLY, THERE ARE C ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
        4 *** SRU RETURN CHECKOLT ***
  IT IS LOCATED AT POSITION 13 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS.
             72.00, 0.00, 0.00,
       1.00.
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE 5.
 THE 1 CUT FUT PROCESSES ARE 30,
 GUTPUT SCHEME Q IS USED
  1 ITEMS CAN BE PROCESSED SIMULTANEGUSLY.
 INITIALLY, THERE ARE C ITEMS BEING PRICESSED.
 THE INITIAL PROCESS STATUS IS OPEN
PROCESS 5 *** PAYLOAD RETURN SEPARATION ***
 IT IS LOCATED AT POSITION 28 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 25 HAS 1 DESCRIPTORS.
 REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE 13.
 THE 8 CUT PUT PROCESSES ARE 1, 3, 30, 4,
 OUTPUT SCHEME 16 IS USED
 +0 ITEMS CAN BE PROCESSED SIMULTANEGUSLY.
 INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS OPEN
PROCESS 10 *** SATELLITE ASSEMBLY/TEST ***
  IT IS LOCATED AT POSITION 491 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 38 HAS 10 DESCRIPTORS.
      1.00, .00, 0.00, 1.00,
                                                   0.00, 0.00, 0.00, 0.00,
                                          5.00.
       0.00.
  REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE I INPUT PROCESSES ARE 44.
 THE 1 CUTPUT PROCESSES ARE 32,
  CUTPLI SCHEME O IS USED
 *O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
```

```
PROCESS 11 *** LANDING/SAFING
  IT IS LOCATED AT POSITION 351 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS.
       1.00, 9.60, 0.00, 0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE 52.
 THE 1 CUT PUT PROCESSES ARE 13.
  CUTPUT SCHEME O IS USED
  5 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
PROCESS 13 *** PAYLOAD REMOVAL/SHUTTLE MAINTEN. ***
  IT IS LOCATED AT POSITION 332 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 34 HAS 7 DESCRIPTORS.
       1.00, 60.80, 0.00, 1.00, 10.00, 0.00, 0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 2 CUT PUT PROCESSES ARE 19, 5,
  DUTPUT SCHEME 11 IS USED
  1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
PROCESS 15 *** SRU REMORK
  IT IS LOCATED AT FOSITION 547 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 46 HAS 4 DESCRIPTORS.
       1.00, *95999.00, 0.00, 0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE 5.
  THE 1 CUTPUT PROCESSES ARE
   CUTPUT SCHEME O IS LSED
  *O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS SPECIAL
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IT IS LOCATED AT POSITION 203 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 32 HAS 8 DESCRIPTORS.
              730.00, 0.00, 0.00, 0.00, 0.00,
                                                              0.00.
       1.00.
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 3 INPUT PROCESSES ARE 13, 32, 31,
 THE I CUT PUT PROCESSES ARE 24.
   CUTPUT SCHEME TO IS USED
  5 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS SPECIAL
PROCESS 24 *** SHUTTLE ASSEMBLY ***
  IT IS LOCATED AT POSITION 381 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE -1 HAS 4 DESCRIPTORS.
       1.00, 0.00,
                         0.00, 0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE 19,
 THE 1 INPUT PROCESSES ARE 19,
THE 1 CUT FUT PROCESSES ARE 27,
   CUTPUT SCHEME O IS USED
  1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
PROCESS 27 *** LAUNCH
 ACTIVITY COST TRANSFORMATION 6 HAS 13" DESCRIPTORS.
    13006.00, 254.86, 3200.00, 890.91, 3200.00, 280.00, 3200.00, 1113.64, 3200.00,
     280.00, 6000.00, 1113.64, 6000.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  IT IS LOCATED AT POSITION 396 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS.
                         0.00.
                                  0.00.
       1.00.
                0.00.
   REFER TO THE PROCESS, EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE 24.
 THE I CUT PUT PROCESSES ARE 39,
   CUTPUT SCHEME O IS USED
  1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE C ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
```

```
PROCESS 30 *** SRU PAYLOAD HOLD/RELEASE ***
     IT IS LOCATED AT POSITION 98 OF THE INTERNAL COMPUTER LIST AREA.
    PROCESS TRANSFORMATION TYPE 40 HAS 2 DESCRIPTORS.
                  0.00,
       REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
    THE 1 INPUT PROCESSES ARE 42+
    THE 1 CUT PUT PROCESSES ARE 19;
       OUTPUT SCHEME 2 IS USED
    *O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
    INITIALLY, THERE ARE C ITEMS BEING PROCESSED.
    THE INITIAL PROCESS STATUS IS OPEN
PFOCESS 31 *** DUMMY INSERT SHUTTLES ***
      IT IS LOCATED AT POSITION 224 OF THE INTERNAL COMPUTER LIST AREA.
    PROCESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS.
       -0.00, -0.00, -0.00, -0.00,
        REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
    THE 1 INPUT PROCESSES ARE -1.
    THE 1 CUT PUT PROCESSES ARE 19,
        OUTPUT SCHEME O IS LSED
      4 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
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    INITIALLY, THERE ARE 4 ITEMS BEING PROCESSED.
    THE INITIAL PROCESS STATUS IS CLOSED
PROCESS 32 *** SATELLITE HULD/RELEASE ***
      IT IS LOCATED AT POSITION 512 OF THE INTERNAL COMPUTER LIST AREA.
     PROCESS TRANSFORMATION TYPE 35 HAS 5 DESCRIPTORS.
                   0.00, 0.00, 0.00, 0.00,
         REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
     THE 3 INPUT PROCESSES ARE 1, 10, 3,
     THE 1 CUT PUT PROCESSES ARE 19.
        CUTPUT SCHEME 2 IS USED
       O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
     INITIALLY. THERE ARE O ITEMS BEING PROCESSED.
     THE INITIAL PROCESS STATUS IS OPEN
```

PROCESS 39 \*\*\* LAUNCH INTO ORBIT \*\*\*

IT IS LOCATED AT POSITION 239 OF THE INTERNAL COMPUTER LIST AREA.

PROCESS TRANSFORMATION TYPE 33 HAS 9 DESCRIPTORS.

```
1.00, .00, 0.00, 1.00, 0.00, 0.00, 2.00, 0.00, 0.00, REFER TO THE PRUCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
    THE 1 INPUT PROCESSES ARE 27.
    THE 5 CUT PUT PROCESSES ARE 199, 52, 45, 45, 45,
     1. ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
QUALITY
    INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
    THE INITIAL PROCESS STATUS IS OPEN
PROCESS 42 *** SRU REPLACEMENT
     IT IS LOCATED AT POSITION 530 OF THE INTERNAL COMPUTER LIST AREA.
     PROCESS TRANSFORMATION TYPE 37 HAS 5 DESCRIPTORS.
                     .00, 0.00, -1.60, 0.00,
      REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
    THE 1 INPUT PROCESSES ARE 2.
     THE 2 CUT PUT PROCESSES ARE
      CUTPUT SCHEME 14 IS USED
    *O ITEMS CAN BE PROCESSED SIMULTANEGUSLY.
     INITIALLY, THERE ARE C ITEMS BEING PRECESSED.
     THE INITIAL PROCESS STATUS IS OPEN
   PROCESS 44 *** SPACE CRAFT EQUIP. MFG
     ACTIVITY COST TRANSFORMATION 5 HAS 2 DESCRIPTORS.
        2005.00.
      REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
     IT IS LOCATED AT PUSITION 465 OF THE INTERNAL COMPUTER LIST AREA.
     PROCESS TRANSFORMATION TYPE 37 FAS 12 DESCRIPTORS.
                                                                     3.00, 4.60,
                                                          2.00.
                     .00.
                                        8.00, 1.00,
          1.00.
                   13.00 .
                             21.00.
      REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
     THE 1 INPUT PROCESSES ARE 1.
     THE 1 CUTPUT PROCESSES ARE
      CUTPUT SCHEME O IS USED
     *O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
     INITIALLY: THERE ARE O ITEMS BEING PROCESSED.
     THE INITIAL PROCESS STATUS IS GPEN
```

PROCESS 45 \*\*\* SHUTTLE/SATELLITE DISENSACEMENT \*\*\*
IT IS LOCATED AT POSITION 279 OF THE INTERNAL COMPUTER LIST AREA.

O.OO.  REFER TO THE PROCES THE 1 INPUT PROCESSES THE 9 CUTPUT PROCESS CUTPUT SCHEME 10 IS 1 ITEMS CAN BE PROCE INITIALLY, THERE ARE THE INITIAL PROCESS S	S ARE 39. SES ARE 52. 19 S USED ES SED SIMULTANEOU O ITEMS BEING P	1, 152,		•			
THE 1 INPUT PROCESSES THE 9 CUTPUT PROCESS CUTPUT SCHEME 10 IS 1 ITEMS CAN BE PROCE INITIALLY, THERE ARE	S ARE 39. SES ARE 52. 19 S USED ES SED SIMULTANEOU O ITEMS BEING P	1, 152,		•			
THE 9 CUTPUT PROCESS  CUTPUT SCHEME 10 IS  1 ITEMS CAN BE PROCE INITIALLY, THERE ARE	SES ARE 52: 19 S USED ES SED SIMULTANEOU O ITEMS BEING P	ISLY.	-1, 192,	191, 52,	65, 66,		To a second
OUTPUT SCHEME 10 IS 1 ITEMS CAN BE PROCE INITIALLY, THERE ARE	S USED ES SED SIMULTANEOU O ITEMS BEING P	ISLY.	-1, 192,	191. 52.	05+ 00+	•	
1 ITEMS CAN BE PROCE INITIALLY, THERE ARE	S SED SIMULTANEOU O ITEMS BEING P					•	
INITIALLY, THERE ARE	O ITEMS BEING P					<u> </u>	
THE INITIAL PRIMESS		KECE2SED*			•		
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PROPERT TO 144 BETI	IDA COCH ADDIT		***				1 0
PROCESS 52 *** RETU	UNN CREM UNDII CITION 363 OF TH	E THITECHAL	to the same without the control of the same of the sam	ST AREA.	e reconstruction spinor artificioniste que la spinital dispulgation an	<u> </u>	<u> </u>
PROCESS TRANSFORMATIO				OI MILMA		•	
1.00, 8.0			nu •				
REFER TO THE PROCES	SS EYDIANATION FO	R THE MEAN	ING OF THE	BOVE VALUES			
THE 2 INPUT PROCESSES							
THE 1 CUTFUT PROCESS							
CUTPUT SCHEME O IS					,,, max		
1 ITEMS CAN BE PROCE		JSLY.		• •		•	
INITIALLY, THERE ARE							
THE INITIAL PROCESS	STATUS IS OPEN				•		
				·			
PROCESS 65 *** SATE	ELLITE IN ORBIT		***			•	
IT IS LOCATED AT POS	SITION 126 OF TH	IE INTERNAL	COMPUTER L	IST AREA.		•	
PROCESS TRANSFORMATIO	DN TYPE 36 HAS 10	) DESCRIPTO	RS.			0.00	0.00
87600.00, 0.0	0.00,	1.00,	1.00,	0.00,	0.00,	0.00,	0.0
0.00,	ce funiabation ee	 So tue bear	INC OF THE	ADOVE VALUES		•	
REFER TO THE PROCES		JK THE PEAN	ING OF THE	ABOAT AMEGES			
THE 1 INPUT PROCESSES THE 4 CUT PUT PROCESS		102.	104 -				
CUTPUT SCHEME 12 IS		701 1721	1071				
1 ITEMS CAN BE PROCE	ES SED STMILL TAMEDI	ICT V.		1 -			
INITIALLY, THERE ARE				,			•
THE INITIAL PROCESS							
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					•		
PROCESS 66 *** REPL IT IS LOCATED AT POS	LACE SRU IN SPACE	na -	***				

PRECESS TRANSFORMATION TYPE 27 HAS 2 DESCRIPTORS.

.00, 65.00,

REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE THE 1 INPUT PROCESSES ARE 45.

THE 1 CUT PUT PROCESSES ARE 52.

CONTROL SCHEME O IS USED

1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.

INITIALLY, THERE ARE G ITEMS BEING PROCESSED.

THE INITIAL PROCESS STATUS IS OPEN

PROCESS 79 \*\*\* GENERAL ORDER INSERTION \*\*\*

IT IS LOCATED AT POSITION 562 OF THE INTERNAL COMBUTER REFER TO THE FROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES. IT IS LOCATED AT POSITION 562 OF THE INTERNAL COMPUTER LIST AREA. PROCESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS. 0.00, 0.00, 0.00. REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES. THE 1 INPUT PROCESSES ARE -1, THE 1 CUTFUT PROCESSES ARE 1. CUTPUT SCHEME O IS USED 1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY. INITIALLY, THERE ARE ! ITEMS BEING PROCESSED. THE INITIAL PROCESS STATUS IS CLOSED

PROCESS 103. \*\*\* DECISION MAKING ACTIVITY \*\*\* PROCESS TRANSFORMATION TYPE 2 HAS 4 CESCRIPTORS. IT IS LOCATED AT POSITION 150 OF THE INTERNAL COMPUTER LIST AREA. REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES. THE 3 INPUT PROCESSES ARE 199, 191, 190, THE 1 CUTPUT PROCESSES ARE CUTPUT SCHEME O IS USED \*O ITEMS CAN BE PROCESSED SIMULTANEOUSLY. INITIALLY, THERE ARE C ITEMS BEING PROCESSED. THE INITIAL PROCESS STATUS IS OPEN

PFOCESS 164 \*\*\* ORBITAL OFER. PYLE IT IS LOCATED AT POSITION 111 OF THE INTERNAL COMPUTER LIST AREA. PRICESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS. 0.00. 0.00. REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES. THE 1 INPUT PROCESSES ARE 65.

THE ! CUTFUT PROCESSES ARE 2, CUTPUT SCHEME O IS USED \*O ITEMS CAN BE PROCESSED SIMULTANEOUSLY. INITIALLY, THERE ARE O ITEMS BEING PROCESSED. THE INITIAL PROCESS STATUS IS OPEN PROCESS 190 \*\*\* FAILURE SATELLITE IN CRBIT \*\*\* IT IS LOCATED AT POSITION 451 OF THE INTERNAL COMPUTER LIST AREA. PROCESS TRANSFORMATION TYPE 29 HAS 1 DESCRIPTORS. 5.0C. REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES. THE 3 INPUT PROCESSES ARE 65, -1, -1, THE 1 CUIPUT PROCESSES ARE 103. DUTPUT SCHEME O IS USED \*O ITEMS CAN BE PROCESSED SIMULTANEOUSLY. INITIALLY. THERE ARE G ITEMS BEING PROCESSED. THE INITIAL PROCESS STATUS IS OPEN PROCESS\_191 \*\*\* SATELLITE LOST DISENGAGEMENT .\*\*\* IT IS LOCATED AT POSITION 425 OF THE INTERNAL COMPUTER LIST AREA. PRICESS TRANSFORMATION TYPE 29 HAS 1 DESCRIPTORS. 2.00. REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES. THE 1 INPUT PROCESSES ARE 45. THE 1 CUT FUT PROCESSES ARE 103. CUTPLT SCHEME O IS USED \*O ITEMS CAN BE PROCESSED SIMULTANEOUSLY. INITIALLY, THERE ARE O ITEMS BEING PROCESSED. THE INITIAL PROCESS STATUS IS OPEN PROCESS 192 \*\*\* SHUTTLE LOST DISENGAGEMENT \*\*\* IT IS LOCATED AT POSITION 308 OF THE INTERNAL COMPUTER LIST AREA. PROCESS TRANSFORMATION TYPE 29 HAS 1 DESCRIPTORS. 1.00. REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES. THE 1 INPUT PROCESSES ARE 45. THE 1 CUTPUT PROCESSES ARE -1,

OUTPUT SCHEME O IS USED

\*O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.

INITIALLY, THERE ARE C ITEMS BEING PROCESSED. THE INITIAL PROCESS STATUS IS CPEN PROCESS 193 \*\*\* END OF MISSION IT IS LOCATED AT POSITION 437 OF THE INTERNAL COMPUTER LIST AREA. PROCESS TRANSFORMATION TYPE 29 HAS 1 DESCRIPTORS. 7.0C. REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES. THE 3 INPUT PROCESSES ARE 65, -1, -1, THE 1 CUT PUT PROCESSES ARE -1, DUTPUT SCHEME O IS USED \*O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE O ITEMS BEING PROCESSED. THE INITIAL PROCESS STATUS IS OPEN PROCESS 197 \*\*\* COLLECT ALL SRU RETURNS \*\*\*

IT IS LOCATED AT POSITION 6C OF THE INTERNAL COMPUTER LIST AREA.

PROCESS TRANSFORMATION TYPE 29 HAS 1 DESCRIPTORS. 7.00. REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES. THE 1 INPUT PROCESSES ARE 5,
THE 1 CUT PUT PROCESSES ARE -1,
OUTPUT SCHEME 0 IS USED \*O ITEMS CAN BE PROCESSED SIMULTANEOUSLY. INITIALLY, THERE ARE G ITEMS BEING PROCESSED. THE INITIAL PROCESS STATUS IS OPEN PROCESS 198 \*\*\* SATELLITE RETRIEVAL \*\*\* IT IS LOCATED AT POSITION 1 OF THE INTERNAL COMPUTER LIST AREA.

PROCESS 198 \*\*\* SATELLITE RETRIEVAL \*\*\*

IT IS LOCATED AT POSITION 1 OF THE INTERNAL COMPUTER LIST AREA.

PROCESS TRANSFORMATION TYPE 29 FAS 1 DESCRIPTORS.

7.0C,

REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.

THE 1 INPUT PROCESSES ARE 5,

THE 1 CUTFUT PROCESSES ARE -1,

OUTPUT SCHEME O IS USED

\*O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.

INITIALLY, THERE ARE O ITEMS BEING PROCESSED.

THE INITIAL PROCESS STATUS IS OPEN

PROCESS 199 \*\*\* SHUTTLE LCST LAUNCH IT IS LOCATED AT POSITION 320 OF THE INTERNAL COMPUTER LIST AREA. PROCESS TRANSFORMATION TYPE 29 HAS I DESCRIPTORS. 3.00. REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES. THE 1 INPUT PROCESSES ARE 39. THE 1 CUTFUT PROCESSES ARE 103. DUTPUT SCHEME O IS USED \*O ITEMS CAN BE PROCESSED SIMULTANEOUSLY. INITIALLY, THERE ARE O ITEMS BEING PROCESSED. THE INITIAL PROCESS STATUS IS OPEN \*\*\*\* SHUTTLE/SATELLITE/UNIT DISPOSITION AT START \*\*\*\*\* THE GROEF BOOOL IS SCHEDULED TO LEAVE PRECESS 79 AT 0.000 HOURS. THE SHUTTLE #0001 IS SCHEDULED TO LEAVE PROCESS 31 AT 0.000 HOURS. THERE IS NO PAYLOAD ABCARD THE SHUTTLE #0002 IS SCHEDULED TO LEAVE PROCESS 31 AT 0.000 HOURS. THERE IS NO PAYLOAD ABCARD THE SHUTTLE #0003 IS SCHEDULED TO LEAVE PROCESS 31 AT 0.000 HOLRS. THERE IS NO PAYLOAD ABCARD

THE SHUTTLE #0004 IS SCHEDULED TO LEAVE PROCESS, 31 AT 0.000 HOURS.

THERE IS NO PAYLOAD ABCARD

OF POOR G	海本本は	* SRU/	'NRL UNIT	CESCRIPTIC	<b>//</b> *****					***		ing the supposed of
R AL	NRU -		SOL/	AR ARRAYADR	IVE MOCUL	E	f minute werefreezing to a second		and the second s			
PAG	MCDEL	L SRU	J ECUIV.	1 MEIGHT	199 N	NO. OF	COMP. 12			er om en en en en en en en en en en en en en		
KLITTYND ST. SEDVA	T	/ PE	ALPHA	BETA	CONDITI	ION	DSGN LIFE	COMP.	NAME	COST( DCLLA	IRS J	•
	10601		000000.	1.0000	ACTIVE 1		*)0C00.	AD STR		92000.00		
	10603		00000000	1.0000	ACTIVE 1		*00000.	THER	,	12000.00		
l			4000000	1.C000	ACTIVE 1		*00C00.	A DRIV		45000.00		, ·
	10651 10652		4003000 220410	1.0000 1.0000	STNDBY ACTIVE 1		*00000.	A DRIV AD ELE		45000.00		
	10652		220410		STADBY		*00000.	AD ELE		30000.00		
	10631	02	288684	1.0000	ACTIVE 1		*00 CCO.	DI/SCU		22000.00		
Í	10631	G2	288684	1.0000		.10	*00000.	DI/SCU		22000.00		
1	10611	03	1176471	1.0000	ACTIVE 1		*00C00.	AD PCU	•	25000.00		* ;
	b 10611	03	-1175471	1.0000	STNDBY		*00C00.	AD PCU		25000.00		
	<u>i</u> 10653.		000000.	1.0000	ACTIVE 1		*00000.	ARRAY		528000.00		,
,	ω 10691	.C3 *CC	0000000.	1.0000	ACTIVE 1	L • CC	*00000	HARN		10000.00	MFG.	
	BUILD COS	iΤ .	0250 MILL	ICN CCLLAR	S FA	CTCRS	MFG- 1-2	8 BUY	1.11		# * * * * * * * * * * * * * * * * * * *	12.7
1	and the same of th											
1	NRU		ELE	ECTRIC POWE	R MCDULF				entre anno entre e	•	<u> </u>	
,		e SRU		:		NO. OF	COMP. 12	/e • 10				Alternative spine
	MCOEL 2	P SRU		:			COMP. 12 DSGN LIFE	COMP.	NAME	COSTIDELLA	IRS)	
	MCOEL 2	PE	EQULV.	I WEIGHT	~ 416 × N	101		COMP.	NAME			
	MCOEL 71	(PE .03 +00	J EQULV.	I WEIGHT	416 A	[GN L•CC	DSGN LIFE		NAME	COST(DCLLA 19600.00 18000.00	MFG.	
	MCOEL 71 10301. 10303. 10311.	(PE .03 +00 .01 1	ALPHA 0000000. 0000000000000000000000000000	1 WEIGHT  BFTA  1.0000  1.0000	CONDITI  ACTIVE 1 ACTIVE 1 ACTIVE 1	[GN  -CG  -CG	DSGN LIFE *00000. *00000. *30000.	EP STR THERM - EP PCU	NAME	19500.00	MEG.	
	MCOEL 7 16301. 10303. 16311.	(PE .03 *01 .01 1 .03	ALPHA 0000000. 0000000 400000 400000	1 WEIGHT  BETA  1.0000 1.0000 1.0000	ACTIVE 1 ACTIVE 1 ACTIVE 1 ACTIVE 1 STNDBY	IGN 1-00 1-00 1-00	#00000. #00000. #00000. #00000.	FP STR THERM - EP PCU EP PCU	NAME	19600.00 18000.00 25000.00 25000.00	MFG. MFG. MFG.	
	MCOEL 7 16301. 10303. 16211. 16311.	(PE .03 *00 .01 1 .03 .03	ALPHA 0000000. 0000000 400000 400000 218341	1 WEIGHT  BFTA  1.0000 1.0000 1.0000 1.0000	CONDITI  ACTIVE 1 ACTIVE 1 ACTIVE 1 STNDBY STNDBY	10 N 1 - CC 1 - CC 1 - CC 1 - CC 1 - CC	*00000. *00000. *00000. *00000. *00000.	EP STR THERM - EP PCU EP PCU DI/SCU	NAME	19600.00 18000.00 25000.00 25000.00 39000.00	MEG. MEG. MEG. MEG.	
production of the second	MCOEL 7 16301 10303 10311 10311 10331	(PE .03 *00 .01 1 .03 .03 .01	ALPHA 00000000. 00000000 400000 400000 218341 218341	1 WEIGHT  BETA  1.0000 1.0000 1.0000 1.0000 1.0000	ACTIVE 1 ACTIVE 1 ACTIVE 1 STNDBY STNDBY ACTIVE 1	10 N 1 - CC 1 - CC 1 - CC 1 - CC 1 - CC	*00000. *00000. *00000. *00000. *00000. *00000.	FP STR THERM - EP PCU EP PCU DI/SCU DI/SCU	NAME	19600.00 18000.00 25000.00 25000.00 39000.00	MEG. MEG. MEG. MEG. MEG.	
	MCOEL 7 10301 10303 10311 10331 10331 10331	(PE .03 *00 .01 1 .03 .03 .01 .01	ALPHA 00000000. 00000000 400000 400000 218341 218341 1250000	1 WEIGHT  BETA  1.0000 1.0000 1.0000 1.0000 1.0000 1.0000	ACTIVE 1 ACTIVE 1 ACTIVE 1 ACTIVE 1 STNDBY STNDBY ACTIVE 1 ACTIVE 1	10N 1-CC 1-CC 1-CC 1-CC	#00000. #00000. #00000. #00000. #00000. #00000. #00000.	SP STR THERM - EP PCU EP PCU DI/SCU DI/SCU PCNTRL	NAME	19600.00 18000.00 25000.00 25000.00 39000.00 39000.00 65800.00	MEG. MEG. MEG. MEG. MEG. MEG.	
Commence of the commence of th	MCOEL 7 10301 10303 10311 10311 10331 10351	(PE .03 *00 .01 1 .03 .03 .01 .01 .03 .03	ALPHA 00000000. 00000000 400000 400000 218341 218341 1250000	1 WEIGHT  BETA  1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000	ACTIVE 1 ACTIVE 1 ACTIVE 1 ACTIVE 1 STNDBY STNDBY ACTIVE 1 ACTIVE 1 ACTIVE 1 STNDBY	10 N 1 - CC 1 - CC 1 - CC 1 - CC 1 - CC 1 - CC	#00000. #00000. #00000. #00000. #00000. #00000. #00000.	SP STR THERM - EP PCU EP PCU DI/SCU DI/SCU PCNTRL PCNTRL	NAME	19600.00 18000.00 25000.00 25000.00 39000.00 39000.00 65800.00	MEG. MEG. MEG. MEG. MEG. MEG. MEG.	
	MCOEL 7 10301 10303 10311 10331 10331 10331	(PE .03 *00 .01 1 .03 .03 .01 .01 .03 .03 .03	ALPHA 00000000. 00000000 400000 400000 218341 218341 1250000	1 WEIGHT  BETA  1.0000 1.0000 1.0000 1.0000 1.0000 1.0000	ACTIVE 1 ACTIVE 1 ACTIVE 1 ACTIVE 1 STNDBY STNDBY ACTIVE 1 ACTIVE 1	10 N 1 - CC 1 - CC 1 - CC 1 - CC 1 - CC 1 - CC 1 - CC	#00000. #00000. #00000. #00000. #00000. #00000. #00000.	SP STR THERM - EP PCU EP PCU DI/SCU DI/SCU PCNTRL	NAME	19600.00 18000.00 25000.00 25000.00 39000.00 39000.00 65800.00	MEG. MEG. MEG. MEG. MEG. MEG. MEG. MEG.	

······································		2035 1039		1754386 *00000000000	1.0000 1.0000	ACTIVE		*00000. *00000.	BATTS: HARN		28800.00 17000.00		
	BUI	LD C	OST	.0300 MILL	ICN DCLLAR	S	FAC TORS	MFG. 1.2	S BUY	1.12			
	tracticana a una 1986 anti-lan			1						4.7	÷.	*	
		1			AND DATA	14 A CI T A	10 MEDIL	<b>-</b>					
	NFU			NWED	AND CATA	HANULIN	IC MILLOL						
	MCD	EL	3	SRU EÇUIV.	1 KEIGHT	170	NO. CF	COMF. 25					• • •
-			TYPE	ALPHA	BETA	C CND I	TION	DSGN LIFE	COMP.	NAME	COSTODELLA	RS)	
		1020	1.03	*00000000	1.0000	ACTIVE	1.00	<b>*00000</b> •	CD STR		19600.00	MFG.	
<b></b>		1020			1.0000	ACTIVE	1.CO	<b>*00000.</b>	THERM		13900.00	MFG.	
		1025	6.02	5000000	1.0000	ACTIVE	1.00	*00000.	OMNI		20000.00	BUY	.*
		1025		585 480	1.0000	ACTIVE	1.00	*00000.	XMTR		43000.00		
		1025	2.02	585480	1.0000	SINDBY	.10	*00000.	XMTR		43000.00		
		1025	1.02	. 248694	1.0000	ACTIVE	1.00	<b>*00000.</b>	RCVR		65000.00		
		1 025	1.02	248694	1.0000	ACTIVE	1.00	*00 COO.	RCVR		65000.00		
		1025	3.02	8333333	1.C000	ACTIVE	1.00	<b>*</b> 00000-	DIPLXR	•	32000.00		
li, (	₽	1027	3.02	2159 627	- 4.0000	ACTIVE	1.CG	*00G00	DECOD	* **=	30000.00		and a second control of the control
		1027	3.02	2159827	1.0000	ACTIVE	1.CC	*00000.	DECODE	₹	30000.00		
···	4	1027	4.02	273823	1.0000	ACTIVE	1-00	*00000.	BUSCON		20000.00		
		1027		273823	1.0000	SINDBY	. 10	*00000-	BUSCON		20000-00	MFG.	
		1025		£71.840	1.0000	ACTIVE	1.00	*00000-	BB ASY		12000.00	MFG.	
•		1025	5.02	871840	1.0000	STNUB	.1C	*00CGO-	BB ASY		12000.00		
	•	1021	1.02	400 000	1.0000	ACTIVE	1.00	<b>*00000</b> •	PCU `		25000.00		
		1021	1.02	400000	1.0000	ACTIVE	1.00	*00000.	PCU		25000.00	MFG.	
		1025		4166667	1.0000	ACTIVE	1.CO	*00000-	CMBSW		6500.00	BUY	
		1027	1.02	142857	1.0000	ACTIVE	1.00	*00000•	CPU .		45000.00	BUY	
		1027		142857	1.0000	STNDBY	.10	*00000.	CPU		45000.00	BUY	and the second second second
		2027		291630	1.0C00	ACTIVE	1.00	<b>*00000</b> •	MEM U		35000.00	BUY	
		2027		291630	1.0000	ACTIVE	1.00	*00COO.	MEM U		35000.00		
		2027			1.0000	STADBY		*00000.	MEM U	ا منابع در مانی	35000.00	BUY	
		1023		292 740	1.0000	ACTIVE		*00000.	DI/SCU		22000.00	MFG.	
		1023		292 740	1.0000	STNDBY		*000000.	DI/SCU		22000.00	MFG.	
		-		*0000 C00000.	1.0000	ACTIVE		*000co.	HARN		15000.00	MF G .	
				and the second s						• -			

NRU ----- ATT ITUDE DETERM. MODULE

BUILD COST .0900 MILLION COLLARS FACTORS MEG. 1.29 BUY 1.12

MC	DEL 4	SRU EQUIV.	1 WEIGHT	233 NC	). OF	COMP. 24			
ORIGINAL	TYPE	ALPHA	BETA	CONDITIO	) N	DSGN LIFE	COMP. NAME	COST( DCLL ARS)	
G	10601 03	*000000000	1 6000	ACTIVE 1	00	*00000	IO CTO	10(00 00 NEC	
Ż	10403.01	100000000	1.0000 1.0000	ACTIVE 1.		*00000. *00000.	AD STR Therm	19600.00 MFG. 18000.00 MFG.	
	30451.02	59945	1.0000	ACTIVE 1.		*00C00.	GRA	80000.00 BUY	
	30451.02	59 945	1.0000	ACTIVE 1.		*00CCO.	GRA	80000.00 BUY	*
Marie	30451.02	59545	1.0000	ACTIVE 1.		*00000.	GRA	80000.00 BUY	
- 요	30451.02	59945	1.0000	STNDBY .	. 10	*00000.	GRA	80000.00 BUY	
L PAGE IS	30451.02	59 945	1.0000			*00000.	GRA	80000.00 BUY	•
21 (Q)	30451.02	59945	1.0000			*00000.	GRA	80000.00 BUY	
	20452.01	190259	1.0000	ACTIVE 1.		*00C00.	STAR T	69000.00 BUY	
	20452 • C1	190259	1.0000			*00000.	STAR T	69000.00 BUY	
	20452.C1 10453.C2	190259 714286	1.0000	ACTIVE 1.		*00000.	STAR T	69000.00 BUY	
	10453.02	714286	1.0000 1.0000	STADBY .		*00000.	MAGN MAGN	20000.00 BUY 20000.00 BUY	
	10454.00	12500000	1.0000	ACTIVE 1.		*00000.	SUN	44000.00 BUY	
	10471 · C2	105263	1.0000	ACTIVE 1.		*00000.	XFER A	27500.00 MFG.	ر المحمود المحمود المحمود المحمود المحمود المار المار المار المحمود المار المحمود المحمود المحمود المحمود الم
B-1	10471.C2	105263	1.0000			*00C00.	XFER A	27500.00 MFG.	,
15	10472.01	105263	1.0000	ACTIVE 1.		*00000.	XFER B	27500.00 MFG.	
	10472.01	105263	1.C000			*00000-	XFER B	27500.00 MFG.	
	10473.00	2873563	1.0000	ACTIVE 1.		*00C00.	SAF MD	7000.00 MFG.	
	1.0411.03	400000	1.0000	ACTIVE 1.		*00000.	PCU	25000.00 MFG.	
•	10411.03	400000	1.0000			*300co.	PCU ·	25000.00 MFG.	
	10431.62	215 889	1.0000	ACTIVE 1.		*00000.	DI/SCU	56000.00 MFG.	
	10431.02	215889	1.0000			*00 <u>0</u> 00.	DI/SCU	56000.00 MFG.	n er i sa i remeranti merit eterileren i
	10491.03	*000000000	1.0000	ACTIVE 1.		*00 C 00.	HAPN	16000.00 MFG.	
81	ILC COST	.0960 MILL	ICN CCLLAR	S FAC	TCRS	MFG. 1.2	9 BUY 1.12		
A) m			47.55 HODIN				<b>;</b>		
NR		ACTU	ATION MODUL	- <b>t</b>					
MC	DEL 5	SRU ECUIV.	1 WEIGHT	€05 NO	0. OF	COMP. 21		•	÷ .
	TYPE	ALPHA	BETA	CÜNDİTIC	3 N -	DSGN LIFE	COMP. NAME	COST ( DELL ARS )	
	10501-03	*G0)0C0000.	1.0000	ACTIVE 1.	. 00	*)0000 <b>.</b>	STRUC	24000.00 MFG.	
	10503.01	100000000	1.0000	ACTIVE 1.		*00000.	THERM	18000.00 MFG.	
	10504.02	100000000	1.0000	ACTIVE 1.		*00000 <b>.</b>	PTHER	11500.00 MFG.	

ļ	10551.01	6666667	1.0000	ACTIVE 1.CO	*00000-	RRW	52000.00	BUY	A Company of the Company
	10552.01	6666667	1.0000	ACTIVE 1.CO	*00000.	PRW	52000.00		
	10553.Cl	6666667	1.0000	ACTIVE 1.CO	*00000.	YRW	52000.00		
	10571.C1	309119	1.0000	ACTIVE 1.00	*00C00.	RW EL	26000.00		
	10571.01	309119	1.0000	STNDBY .10	*00000.	RW EL	26000.00		
1	10572.01	309119	1.0000	ACTIVE 1.CC	*00000.	PW EL'	26000.00		
!	10572.01	309119	1.0000	STNDBY .10	*00000.		26000.00		
	10573.01	309119	1.0000	ACTIVE 1.CO	*000000		26000.00		
	10573.01	309119	1.0000	STADBY .10	*00000.	YW EL	26000.00	– –	
	10554.C1	10000000	1.0000	ACTIVE 1.CO	*00000.	RMT	8000.00		
[—————	10555.C1	1000000	1.0000	ACTIVE 1.CO	*00C00.	PMT	8000.00		4000
į	10556.01	10000000	1.0000	ACTIVE 1.CO	*00C00.	YMT	8000.00		
	10574.CI	370370	1.0000	ACTIVE 1.00	*00C00.	MT EL .	25000.00		
	10531.02	215889	1.0000	ACTIVE 1.CC	*00 C CO.	DI/SCU	42000.00		
	10531.C2		1.0000	STNDBY .10	*00000.	DI/SCU	42000.00		· ·
	10557.C3	83333333	1.0000	ACTIVE 1.CO	*00000.	G N2	245000.00		
)	10558.02	2523977	1.0000	ACTIVE 1.CO	*00C00.	N2H4	175000.00		The state of the s
1		*000000000.	1.0000	ACTIVE 1.00	*00000	HARN	16000.00		
!			22 3000	W # 111 F 14 CO	.00000	13941214	10000.00	MT G .	
h	BUILD COST	.0450 MILL	ICN CCLLA	RS FACTORS	MFG.	1.32 BUY 1.50	The second of th		

-----FIVE BANC MSS MPXR-A

MCDEL 11 SRU ECUIV. 1 WEIGHT 210 NO. OF COMP. 26

TYPE	ALPHA	BETA	CENDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10931.01	207900	1.0000	ACTIVE 1.00	*00000.	MPXR	712000.00 BUY
40951.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND1	111000.00 BUY
40951.01	1321004	1.0000	ACTIVE 1.CC	*00C00.	BND1	111000.00 BUY
40951.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND1	111000.00 BUY
40951.01	1321004	1.0000	ACTIVE 1.CO	*00000.	BND1	111000.00 BUY
40951.01	1321004	1.0000	ACTIVE 1.CO	*00000.	BND1	111000.00 BUY
40951.C1	1321004	1.0000	ACTIVE 1.CO	*00000.	BND1	111000.00 BUY
40952.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND2	111000.00 BUY
40952.01	1321004	1.0000	ACTIVE 1.GO	*00000.	BND2	111000.00 BUY
40952.01	1321004	1.0000	ACTIVE 1.CC	*00 COO.	BND2	111000.00 BUY
40952.01	1321004	1.0000	ACTIVE 1.00	*00C00.	BND2	111000.00 BUY
40952.01	1321004	1.0000	ACTIVE 1.00	<b>*00000</b>	BND2	111000.00 BUY
40952.01	1321004	1.0000	ACTIVE 1.CC	*00000.	BND2	111000.00 BUY
40953.01	1321004	1.0000	ACTIVE 1.CO	*>0 COO.	BND3	111000.00 BUY

			,				· ·
	111000.00 BUY	BND3	*00000.	ACTIVE 1.00	1.0000	1321004	40953.01
Y	111000.00 BUY	BND3	*00000.	ACTIVE 1.CO	1.0000	1321004	40953.C1
Y	111000.00 BUY	BND3	*00000.	ACTIVE 1.CO	1.0000	1321004	40953.01
<u>Y</u>	111000.00 BUY	BND3	*00000.	ACTIVE 1.CO	1.0000	1321004	40953.01
Y	111000.00 BUY	BND3	*00CCO.	ACTIVE 1.00	1.0000	1321004	40953.01
Y	111000.00 BUY	BND4	*00000.	ACTIVE 1.CO	1.0000	1321004	40954°•C1
Y	111000.00 BUY	BND4	*00000	ACTIVE 1.00	1.0000	1321004	40.954 • 01
Υ '	111000.00 BUY	BND4	*00C00.	ACTIVE 1.00	1.0000	1321604	40954.01
Y	111000.00 BUY	BNC4	*00000.	ACTIVE 1.00	1.0000	1321004	40954.01
Υ	111000.00 BUY	BND4	*00 C00.	ACTIVE 1.CC	1.0000	1321004	, <del>-</del>
Υ	111000.00 BUY	BND4	*00000.	ACTIVE 1.CO	1.0000		40954.01
	32400.00 BUY	BND5	*00000.	ACTIVE 1.CO	1.0000	1321004 4604 <b>0</b> 5	40954.01 10955.01
	,						<del>-</del>

BUILD COST .03CO MILLICN CCLLARS FACTORS MFG. 1.29 BUY 1.12

NRU -------WIDERAND COH MODULE A

MCDEL 12 SRU EQUIV. 1 WEIGHT 240 NO. OF COMP. 12

)	TYPE	ALPHA	BETA	CONDITION	USGN LIFE	COMP. NAME	COST(DCLLARS)
	10831.01 10832.01 10852.01	13157895 677966 2702703	1.0000 1.0000 1.0000	ACTIVE 1.CC ACTIVE 1.CO ACTIVE 1.CO	*00000. *00000. *00000.	HSMPX DATA PROCESSOR P AMP	3700.00 MFG. 72000.00 MFG. 18100.00 MFG.
	10853.C1 50854.C1 50854.C1	9615385 26315789 26315789	1.0000 1.0000	ACTIVE 1.CO ACTIVE 1.CO ACTIVE 1.CO	*00000. *00000. *00000.	ANTEN DATA CH DATA CH	5100.00 MFG. 1900.00 MFG. 1900.00 MFG.
	50854.01 50854.01	26315789 26315789 26315789	1.0000 1.0000	ACTIVE 1.CO ACTIVE 1.CO ACTIVE 1.CO	*00000. *00000. *00009.	DATA CH DATA CH DATA CH	1900.00 MFG. 1900.00 MFG. 1900.00 MFG.
	50854.01 50854.01 10731.01 10731.01	26315789 26315789 181818 181818	1.0000 1.0000	ACTIVE 1.00 ACTIVE 1.00 STNDBY .10	*00000. *00000. *00000.	DATA CH VTR VTR	1900.00 MFG. 400000.00 BUY 40000.00 BUY

BUILD COST .03CO MILLICN COLLARS FACTORS MEG. 1.29 BUY 1.12

NRU ------NON-REPLACEABLE COMPONENTS

MCDEL 21 SRU EQUIV. 1 WEIGHT 5064 NO. OF COMP. 9

8900.00 MFG. 7000.00 MFG. 7600.00 MFG.		STRUCT	*00000.					
**************************************	287000.00		*UUUUU*	E 1.00	O ACTI	1.0000	. * 000 C COO 00 .	10001.02
7600.00 MFG.		PL STRUCTURE	*00C00.	E 1.CO	O ACTI	1.0000	<b>*000000000.</b>	10002.01
	7600.00	TRING	*00000.	E 1.CO	O ACTI	1.0000	*000000000.	10041.02
5200.00 MFG.	25200.00	ADAPT.	*00000.	E 1.00	O ACTI	1.0000	<b>*000000000</b>	
6100.00 MFG.	16100.00	MECHANISMS	*00000.	E 1.60	O ACTI	1.0000	*CO00CO0000.	10C71.C2
8000.00 MFG.	118000.00	SC THERMAL	*00C00-	E 1.CO	O ACTI	1.0000	*0000C00C0.	10003.01
3000.00 MFG.	233000.00	PL THERMAL	*00000·	E 1.00	O ACTI	1.0000	*0000C00C0.	10021.01
0000.00 MFG.	10000.00	SC HARNESS	*00000.	E: 1.00	O ACTI	1.0000	*0000C000C0.	10091.02
0000.00 MFG.	10000.00	PL HARNESS	*00CCO.	E 1.00	O ACTI	1.0000	*000000000	10081.01
-		28 BUY 1.11	MFG. 1.	FAC TORS	LARS	ICN CCLL	-0600 MILL	BUILD COST
	2 <b>3</b> 3	PL THERMAL SC HARNESS PL HARNESS	*00000. *00000. *00000.	E 1.CO E 1.CO E 1.CO	173A 00 173A 00 173A 00	1.0000 1.0000 1.0000	*000000000. *000000000. *000000000.	10003.01 10021.01 10091.02 10081.01

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	ITEM *		ENTERED		198 AT	-1.000			I 5	SCHEDULED	TO	FINISH	AT	-1.000	HOU
	ITEM *		ENTERED		198.AT	-1:000	HOURS	AND	IS	SCHEDULED	TC	FINISH	AT	-1.000	
	P ITEM *		ENTERED		198 AT	-1.000	HOURS	AND	IS	SCHEDULED	TC	FINISH	AT	-1.000	- 11 -11 -11
	- ITEM *		ENTERED		198 AT	-1.000	HOURS	AND	IS	SCHEDULED	TO	FINISH	AT	-1.000	
	TITEM *		ENTERED		158 AT	-1.000	HOURS	AND	IS	SCHEDULED	TO	FINISH	ΔT	-1.000	
,	ITEM *		ENTERED		158 AT					SCHEDULED				-1.000	
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	: ITEM *	200 001	ENTERED	PROCESS	10 AT	.000	HOURS			SCHEDULED				.000	
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	ITEM *	200 001	ENTERED	PROCESS	32 AT					SCHEDULED				.000	
	ITEM	80003	ENTERED	FRCC ESS	32 AT		HOURS				<del>.</del>	·			
	ITEM *	40000004	ENTERED	FROC ESS	19 AT	.000	HOURS	AND	IS	SCHEDULED	TO	FINISH	AT	730.000	HOUR
	ITEM *		ENTERED		5 AT	-1.000	HOURS	AND	15	SCHEDULED	TO	FINISH	AT	-1-000	
	ITEM *	40000004	ENTERED	PROCESS	24 AT	730.000	HOURS	AND	IS	SCHEDULED	TO	FINISH	ΔT	730.000	
	ITEM *	40000004	ENTERED	PROCESS	27 AT					SCHEDULED				730.000	
	-ITEM *.	4 C C O O C O 4	ENTERED	PROCESS	39 AT					SCHEDULED				730.000	
	ITEM *	200 001	ENTERED	FROCESS	45 AT					SCHEDULED				730.000	
	ITEM	40000004			45 AT					SCHEDULED				730.000	
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l	~	ITEM			ENTERED								SCHEDULED					
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م		ITEM			ENTERED		2 A	<u>YT</u>	9298.948	HOURS		•••••	The second control of the second control of					···
	•	ITEM *	.20	01 001	ENTERED	PFOC ESS	65 A	A T	10558.259								16957.931	
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		ITEM	8	30 001	ENTERED	PROCESS	104 A				ΔND	IS	SCHEDULED	TO	FINISH	ΑT	10558.259	HOUR
,		ITEM		30001	ENTERED	PROCESS	2 A		10558.259					APPA, A TELEVISION IN		<b></b>		
		ITEM *	20	11001	ENTERED	PROCESS	65 A										47348.978	
ŧ		ITEM			ENTERED		-						SCHEDULED	TC	FINISH	AT	16957.931	HOUR
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	ш	ITEM	5								AND	I S	SCHEDULED	TC	FINISH	ΑT	16957.931	HOUR
	!	TIFM		0 001	ENTERED	PROCESS	2 ∆	١Ţ	16957.931	HOURS								
	Ö	ITEM *	20	1001	ENTERED	PROCESS	65 A	۱T.	47348.978	HOURS	AND	IS	SCHEDULED	TC	FINISH	AT	50859.592 47348.578	HOUR
;		ITEM	8	30001	ENTERED	. PROCESS	65 A	١Ť	47348.978	HOURS	AND	IS	SCHEDULED	TO	FINISH	AT	47348.578	HOUR
i	1.60	00126E+	06 1	. 1010	00E+03	1.04710	2E+06 1.	00	10 C2E+06	1.0526	3 OE+	06						
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		ITEM	٤	10000	ENTERED	PROCESS	1 C4 A	Ţ	47348.978	HOURS	AND	2.1	SCHEDULED	TO	FINISH	AT	47348.978	HOUR
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<u>.</u>		ITEM +	20	1 001	ENTERED	PROCESS	190 A	T	50859.592	HOURS		•						
		ITEM	E	0 002	ENTERED	PROCESS	190 A	T	50859.592	HOURS	AND	15	SCHEDULED	TO	FINISH	ΑT	50859.592	HOUR
		ITEM.			ENTERED												50859.592	
	-	ITEM	8	0 002	ENTERED	PROCESS	2 A	T	5 0859 . 592	HOURS	AND	ΙS	SCHEDULED	TO	FINISH	ΔŢ	50859.592	HOUR
÷		ITEM	8	10002	ENTERED	PROCESS	1 A 1 A	۱Ŧ Ï	5 C859 .592		-						· · · · · · · · · · · · · · · · · · ·	
		ITEM	8	0001	ENTERED	PROCESS	1 A	T	5 C859 . 592	HOURS	AND	ΞS	SCHEDULED	TO	FINISH	ΔŢ	50859.592	HOUR
:		ITEM		0 003	ENTERED	PROCESS	1 A	T	5,0859.592	HOURS	AND	15	SCHEDULED	TO	FINISH	AT	50859.592	HOUR
		ITEM	Ε	0 002	ENTERED	PROCESS	1 A 32 A 32 A	Ť	50859.592	HOURS	AND	IS	SCHEDULED	TC	FINISH	ΑT	50859.592	HOUR
		ITEM	8	0 0 0 2	ENTERED	PROCESS	32 A	T	5 (859.592			•			•			
		ITEM	ε	0 003	ENTERED	FROCESS	32 A	T	5 (859.592								* •	
		ITEM	8	0001	ENTERED	PROCESS.	44 A	Ť	5 (859.592								The detailer of the	***
		TTEM *			ENTERED						AND	15	SCHEDULED	TO	FINISH	ΑT	50859.592	HOUR
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               2002 ENTERED PROCESS
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                                                 -1.000 HOURS AND IS SCHEDULED TO FINISH AT
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   ITEM *
               3002 ENTERED PROCESS
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QQ ITEM *
               4002 ENTERED PROCESS
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               5 CO2 ENTERED FROCESS
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OR LITEM *
               11 002 ENTERED PROCESS
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               13 CO2 ENTERED PROCESS
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              200002 ENTERED PROCESS
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              200 002 ENTERED PROCESS
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           3CCOOCO3 ENTERED PROCESS
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                                                51597.592 HOURS AND IS SCHEDULED TO FINISH AT
    I TEM
           3 CCOO CO3 ENTERED PROCESS
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    ITEM
           30000003 ENTERED PROCESS
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                                                51607.192 HOURS AND IS SCHEDULED TO FINISH AT
    ITEM
           30000003 ENTERED PROCESS
                                         19 A-T
                                                51667.992 HOURS
    ITEM *
             201 CO2 ENTERED PROCESS
                                         65 AT
                                                55853.247 HOURS AND IS SCHEDULED TO FINISH AT
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    ITEM
              80 001 ENTERED PROCESS
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                                                55653.247 HOURS AND IS SCHEDULED TO FINISH AT
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             201002 ENTERED PROCESS
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                                                57494.246 HOURS AND IS SCHEDULED TO FINISH AT 59776.136 HOUR
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              80 001 ENTERED PROCESS
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                                                57494.246 HOURS AND IS SCHEDULED TO FINISH AT 57494.246 HOUR
              2. CO1000E+03
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2.500126E+06
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                                        104.AT 57494.246 HOURS AND IS SCHEDULED TO FINISH AT 57494.246 HOUR
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i	ITEM *			PROCESS	190 AT		HOURS						,		
	ITEM			FROC ESS	190 AT	59776.136	HOURS	AND	IS	SCHEDULED	10	FINISH	AT	59776.136	HOUR
	ITEM			PROC ESS	103 AT	59776.136	HOURS	AND	IS	SCHEDULED	TO	FINISH	AT	59776.136	
r	ITEM			PROCESS	2 AT	59776.136	HOURS	AND	15	SCHEDULED	TO	FINISH	AT	59776.136	
}	ITEM			PROCESS	1 AT	59776.136	HOURS				- 1	N. P. L.			
	ITEM			PROCESS	1 AT	59776 - 136	HOURS	AND	1 S	SCHEDULEO	TO	FINISH	ΔŤ	59776.136	HOUR
<u> </u>	ITEM			PROCESS	1 AT	59776.136	HOURS	AND	ΙS	SCHEDULED	TO	FINISH	AT	59776.136	HOUR
	ITEM			PROCESS	1 AT	59776.136	HOURS	GNA	ĨS	SCHEDULED	TO	FINISH	ΔŢ	59776.136	
	ITEM			PROCESS	22 AT	59776.136	HOURS				• -	, 2.,,20,,	,,,	371100130	11001
	ITEM			PROCESS	32 AT	59776.136									•
ļ	I TEM			FROCESS	44 AT	59776.136			- remain age.						<del></del>
	ITEM *			PROC ESS	44 AT			AND	IS	SCHEDULED	TO`	FINISH	ΔΤ	59776.136	HUNTO
į	ITEM *			PROC ESS	198 AT	-1.000	HOURS	AND	IS	SCHEDULED	TO	FINISH	ΔŤ	-1.000	
	ITEM *			PROC ESS	198 AT	-1.000	HOURS	AND	ĪŠ	SCHEDULED	10	FINISH	ΔŤ	-1.000	
	ITEM *			PROCESS	198 AT	-1.000	HOURS	AND	ĪŠ	SCHEDULED	To	FINISH	ΔŤ	-1.000	
,	ITEM *	5003	ENTERED	PROCESS	198 AT	-1.000	HOURS	AND	TS	SCHEDULED	TC	FINISH	ΛT	-1.000	
1	ITEM *	11003	ENTERED	PROCESS	198 AT	-1.000	HOURS	AND	IS	SCHEDULED	Tn	FINICH	<u>Λ</u> Τ	-1.000	
1	ITEM *	13003	ENTERED	FROC ESS	198 AT	-1.000	HOURS	AND	I S	SCHEDULED	10	FINISH	AT	-1.000	
}	ITEM *	21 003	ENTERED	PRÓCESS	158 AT	-1.000	HOURS	AND	15	SCHEDULED	7.0	FINISH	AT	-1.000	
	ITEM *	1003	ENTERED	PROCESS	TAO	-1.000	HOURS	AND	7.5	SCHEDULED	TO	FINISH	ΛT	-1.000	-
	H ITEM *	200 003	ENTERED	PROCESS	10 AT	59776 . 136	HOURS	AND	īs	SCHEDULED	TO :	FINISH	AT.	59776.136	HOUR
	_ TITEM *	200 003	ENTERED	PROCESS.	32 AT	59776.136	HOURS	, , , , ,		JOHLOOLLD	10	. 1141.511	м !	231101130	HUUK
	NITEM *			FROCESS	32 AT	59776.136				** - *					
	1 TEM *			PROCESS	OAT			ANO	15	SCHEDULED	TO	EINICH	AT	-1.000	йона
1	ITEM *			PROCESS	72 AT	55776.136	HOURS	AND	15	SCHEDULED	TO	FINICH	AT	59776.136	HOUR
	ITEM	80003	ENTERED	FROCESS	32 AT	59776.136	HOURS	, ,,			.1.2	1 1113 313		37110.130	HUUK
	· ITEM *	20000002			19 AT			ΔND	2.5	SCHEDULED	TO (	ETMICH	A T	60506.136	нопо
	ITEM *			FROCESS	3 AT	-1.000	HOURS	AND	15	SCHEDULED	TO 1	FINISH	AT.	-1.000	_
	ITEM *	20000002			24 AT	60506.136	HULLRS	AND	15	SCHEDIN EO	To	FTMTCH	AT	60506.136	
:	ITEM *	20000002	ENTERED	FROCESS	27 AT	6 0506 - 136	PRUCH	ANID	7.5	SCHEDULED	70	CINITON	AT	60506.136	
ì		20000002			39 AT	60506-136	HOURS	AND	15	SCHEDULED	10 1	E LVIL CH	AT	60506.136	
		200 003			45 AT	6C506.136	HOURS	AND	15	SCHEDULED	TC	EINICH Fratsu	#1.1 A T	60506.136	
		2000002			45 AT	6C506.136	HOURS	AND	ŤŠ	SCHEDULED	TO 4	E INTON	M T	60506.136	
	ITEM *			FROC ESS		6.0506.135	HOURS	AND	15	SCHEDULED.	TO	FINISH	AT	66035.254	
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1	<b>60</b> 506.			975576	50130	8187		Ô	1						•
L	ITEM	20000002			52 AT	60506.136	HOURS	_		SCHEDULED.	to s	E TNT SH	ΑТ	50514.136	ыппы
		2000002			11 AT	60514.136	HOURS	AND	ïŠ	SCHEDULED	TO	FINICH		60523.736	
		20000002				60523.735	HOURS	AND	15	SCHEDULED	TO F	FINISH	ΔT	60584.536	
, .		2 C C O O O O 2			19 AT	6 0584 • 536	HOURS					1111 311	~ ·	OG J074 J36	HUUK
	ITEM *		ENTERED			66035.254		AND	15	SCHEDULED	TO 4	TNI CH	Λ T	69579.776	МΩшп
	ITEM		ENTERED			66035 - 254	HOURS	ANO	1 5	SCHEDULED -	Til E	THICH	M I A T	66035.254	HOUR
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3.400126E+06 3.101000E+03 4.095401E+06 1.004006E+06 9.999999E+07
  1.000000E+00
                 80 001 ENTERED PROCESS 104 AT 66035.254 HOURS AND IS SCHEDULED TO FINISH AT 66035.254 HOUR
      ITEM
                 80 001 ENTERED PROCESS 2 AT 66035.254 HOURS
      ITEM
                201 003 ENTERED PROCESS 65 AT 65579.776 HOURS AND IS SCHEDULED TO FINISH AT 73828.061 HOUR 80001 ENTERED PROCESS 65 AT 65579.776 HOURS AND IS SCHEDULED TO FINISH AT 69579.776 HOUR
       ITEM *
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                 2.901000E+03 3.045102E+06 1.0030C6E+06 9.999999E+07
 3.400126E+06
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                                            1 C4 AT 65579.776 HOURS AND IS SCHEDULED TO FINISH AT 69579.776 HOUR
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                                           2 AT 65579.776 HOURS
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                 80001 ENTERED PROCESS
                201 003 ENTERED PROCESS 65 AT 73828.061 HOURS AND 15 SCHEDULED TO FINISH AT, 73828.061 HOUR AND 15 SCHEDULED TO FINISH AT, 73828.061 HOUR
      ITEM *
      ITEM
  3.400126E+06 2.90100CE+03 2.045201E+06 1.0020C3E+06 9.51290CE+05
  1.0C0C00E+00
                                             104 AT 72828.061 HOURS AND IS SCHEDULED TO FINISH AT 73828.061 HOUR
       ITEM
                  80001 ENTERED PROCESS
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                  80001 ENTERED PROCESS
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201003 ENTERED PROCESS 190 AT 77554.232 HOURS
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                 80 CO2 ENTERED PROCESS 190 AT 77554.232 HOURS AND IS SCHEDULED TO FINISH AT 77554.232 HOUR
    m ÎTEM
    L ITEM
                                          103 AT 77554.232 HOURS AND IS SCHEDULED TO FINISH AT 77554.232 HOUR
                 80 002 ENTERED PROCESS
                                          2 AT. 77554.232 HOURS AND IS SCHEDULED TO FINISH AT 77554.232 HOUR
                  80 002 ENTERED PROCESS
    ω ITEM
                 80 002 ENTERED PROCESS 1 AT 77554.232 HOURS
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1 AT 77554.232 HOURS AND IS SCHEDULED TO FINISH AT 77554.232 HOUR
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                 ### 1 17554.232 HOURS AN 80 CO2 ENTERED PROCESS 32 AT 77554.232 HOURS 80 CO3 ENTERED PROCESS 32 AT 77554.232 HOURS 80 CO1 ENTERED PROCESS 44 AT 77554.232 HOURS 1004 ENTERED PROCESS 44 AT 77554.232 HOURS
       I TEM
       ITEM
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       ITEM
                                          44 AT 77554.232 HOURS 44 AT 77554.232 HOURS AND IS SCHEDULED TO FINISH AT 77554.232 HOUR
                  1004 ENTERED PROCESS
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                  2004 ENTERED PROCESS
                  3004 ENTERED FROCESS
       ITEM *
                  4004 ENTERED PROCESS
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                  5004 ENTERED FROCESS
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       ITEM *
                 13004 ENTERED PROCESS
       ITEM *
       ITEM *
                 21004 ENTERED FROCESS
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                200 004 ENTERED FROCESS 10 AT 77554.232 HOURS AND IS SCHEDULED TO FINISH AT 77554.232 HOURS 200 004 ENTERED FROCESS 32 AT 77554.232 HOURS
       ITEM *
       I TEM *
       ITEM *
                200 CO4 ENTERED PROCESS 32 AT 77554.232 HOURS
       ITEM *
                                          O AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT . -1.000 HOUR
               80002 ENTERED FROCESS
       ITEM *
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200 004 ENTERED PROCESS 32 AT 77554.232 HOURS AND IS SCHEDULED TO FINISH AT 77554.232 HOURS 80 003 ENTERED PROCESS 32 AT 77554.232 HOURS 19 AT 77554.232 HOURS AND IS SCHEDULED TO FINISH AT 78284.232 HOURS 200 004 ENTERED PROCESS 2 AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000 HOURS AND IS SCHEDULED TO FINISH AT -1.000
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             ITEM * 10000001 ENTERED PROCESS
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             ITEM * 1 CCOO CO1 ENTERED PROCESS
             ITEM * 200 004 ENTERED PROCESS 45 AT 78284.232 HOURS AND IS SCHEDULED TO FINISH AT 78284.232 HOUR ITEM 1000001 ENTERED PROCESS 45 AT 78284.232 HOURS AND IS SCHEDULED TO FINISH AT 78284.232 HOUR
             ITEM * 201 004 ENTERED PROCESS 65 AT 78284.232 HOURS AND IS SCHEDULED TO FINISH AT 81068.253 HOUR
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1CC00001 ENTERED PROCESS 52 AT 78284.232 HOURS AND IS SCHEDULED TO FINISH AT. 78292.232 HOUR
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                         10000001 ENTERED PROCESS 11 AT 78292.232 HOURS AND IS SCHEDULED TO FINISH AT 78301.832 HOUR 10000001 ENTERED PROCESS 13 AT 78301.832 HOURS AND IS SCHEDULED TO FINISH AT 78362.632 HOUR 10000001 ENTERED PROCESS 19 AT 78362.632 HOURS
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             ITEM | 1 GCOOOO1 ENTERED PROCESS
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            ITEM * 201004 ENTERED PROCESS 65 AT 81068.253 HOURS AND IS SCHEDULED TO FINISH AT 82595.060 HOUR ITEM 80001 ENTERED PROCESS 65 AT 81068.253 HOURS AND IS SCHEDULED TO FINISH AT 81068.253 HOUR
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	SIMULATION	REPLACEMENT	SERVICE	OPER ATING		SIMULATION		· · · · · · · · · · · · · · · · · · ·
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	52	2	0	98.333	1.667	52		
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	70	2 -	0	98.322	1.667	70		

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	74	1	0	99.167	-833	74		
	75	3	0	97.5CO	2.500	<b>7</b> 5		
	76	2	0	98.333	1.667	76		
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<u></u>	79	3	. 0	97.500	2.500	79		
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	81	. 2	O .	98.333	1.667	٤1		
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p. p. r. r. r	88			99.1.67	.833	88		
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## \*\*\* SHUTTLE LAUNCH TIME DISTRIBUTION \*\*\*

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# \*\*\*\* SERVICE FLIGHT INITIATION STATISTICS \*\*\*\*\*

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# \*\*\* REPLACEMENT SATELLITES MISSICN FREQUENCY DISTRIBUTION \*\*\*

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						•				STAN	ID AR	D CEVIATION =	1.18		•			

#### \*\*\* SRU MODELS DOWN SUMMARY \*\*\*

THERE WERE NO ENTRIES IN THE DISTRIBUTION

\*\*\* SRU MODELS REWORKED \*\*\*

THERE WERE NO ENTRIES IN THE DISTRIBUTION

\*\*\*\*\* SATELLITE SERVICE VISITS \*\*\*\*

\*\*\* NUMBER OF SATELLITES VISITED PER MISSION \*\*\*\*

THERE WERE NO ENTRIES IN THE DISTRIBUTION

\*\*\*\*\* ACTIVITY CEST SUMMARY.

\*\*\*\*

IC	NAME/DESCRIPTION	START"	FÏNISH	COST	(MILLIONS		
		HFS *	HRS *	MIN	AVG	X AM	STD DEV
27	LAUNCH	-1.0	-1.0	1.531	5.344	12.250	1.805
44	SPACECRAFT EQUIP. MFG	-1 · C	-1.0	12.125	42.315	96.598	14.294
•	**** ACTIVITY TOTALS ****		•	13.656	47.659	109.248	16.100

<sup>\*</sup> TYPICAL TIME FOR IST ITEM ENTRY AND LAST ITEM COMPLETION FOR MISSION SIMULATION 100.

### \*\*\* MISSION COST (MILLICNS) \*\*\*

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	UCG5800N. JW65705.	243761.	WRCBLESKI.J.	1921	LINES.	LQ20.	******
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	UCG5800N. JW65705.	243761.	WRCBLESKI, J.	1921	LINES.	LQ20.	******
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	UCG5800N. JW65705.	243761.	WRESHESKI. I.	1021	LINES.	L020.	******
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	UCG5800N. JW65705.	243741	WRCBLESKI,J.	1021	LINES.	0.050	*****
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	HEAR OND AS A EZOF	2/27/41	POCOLCENT :	1001	1 15175	4.000	
	UCG5800N. JW65705.	240161*	WR CBLESKI.J.	1921	LINES.	LQ20.	****

## APPENDIX C

REPRESENTATIVE MISSION SIMULATION FOR LAUNCH-AND-RESUPPLY SHUTTLE MODE

\*SATELLITE LIFE CYCLE COST MCDEL\*

DATE: 09/13/74.

RUN DESCRIPTION: ECS - RESUPPLY, NOM., PAYLOAD A, 1 MO., FLY CLASS 2 FAIL

NUMBER OF SIMULATIONS:

100

FAILURE RATE K FACTOR: 1.000 (INCLUDED IN PRINTED MTBF VALUES)

```
PROCESS 1 *** SATELLITE FLIGHT SCHEDULING ***
  IT IS LOCATED AT POSITION 167 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 28 HAS 21 DESCRIPTORS.
       1.00, 1.00, 0.00, 730.00, 1.00, 1.00, 0.00, 14.00, 0.00,
       0.00, *99999.00, *99999.00, 0.00,
                                                  0.00, 0.00, 0.00, 1.00,
                                          C.00,
       1.00, 0.00,
                        0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 3 INPUT PROCESSES ARE 5, 2, 79,
 THE 3 OUTFUT PROCESSES ARE 32, -1, 44,
   CUTPUT SCHEME 15 IS USED
 *O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
PROCESS 2 *** SRU REPLACEMENT SCHEDULING ***
  IT IS LOCATED AT POSITION 72 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 39 HAS 11 DESCRIPTORS.
      98.00, 0.00, 730.00, *5999.00, 4.00, *99999.00, *59999.00, *99999.00, *59999.00,
       6. CC.
            0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 3 INPUT PROCESSES ARE 104, 103, 42,
 THE 3 OUTPUT PROCESSES ARE 42, 30, 1,
   CUTPUT SCHEME 13 IS USED
 *O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
PROCESS 3 *** SATELLITE CHECKOUT
  IT IS LOCATED AT POSITION 366 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS.
       1.00.
                        C.OC. 0.00.
              72.00.
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE 5.
 THE 1 DUTPUT PROCESSES ARE 32.
  OUTPUT SCHEME O IS USED
 10 ITEMS CAN BE PROCESSED SIMULTANECUSLY.
```

```
INITIALLY, THERE ARE O ITEMS BEING PROCESSED.

THE INITIAL PROCESS STATUS IS GPEN
```

PROCESS 4 \*\*\* SRU RETURN CHECKCUT \*\*\*

IT IS LOCATED AT POSITION 13 OF THE INTERNAL COMPUTER LIST AREA.

PROCESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS.

1.00, 12.00, 0.00, C.00,

REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.

THE 1 INPUT PROCESSES ARE 5,

THE 1 OUTPUT PROCESSES ARE 3C,

CUTPUT SCHEME 0 IS USED

1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.

INITIALLY, THERE ARE 0 ITEMS BEING PROCESSED.

THE INITIAL PROCESS STATUS IS OPEN

PROCESS 5 \*\*\* PAYLOAD RETURN SEPARATION \*\*\*

IT IS LOCATED AT POSITION 28 OF THE INTERNAL COMFUTER LIST AREA.

PROCESS TRANSFORMATION TYPE 25 HAS 1 DESCRIPTORS.

0.00.

FEFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.

THE 1 INPUT PROCESSES ARE 13,
THE 8 OUTPUT PROCESSES ARE 1, 3, 30, 4, 2, 15, -1, 158,
OUTPUT SCHEME 16 IS USED
\*O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE 0 ITEMS BEING PROCESSED.

PROCESS 10 \*\*\* SATELLITE ASSENBLY/TEST \*\*\*

IT IS LOCATED AT POSITION 491 CF THE INTERNAL COMPUTER LIST AREA:

THE INITIAL PROCESS STATUS IS OPEN

PROCESS TRANSFORMATION TYPE 38 HAS 10 DESCRIPTORS.

1.00, .CO, C.0C, 1.00, 5.00, 0.00, 0.00, 0.00, C.00,
0.00.

REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES. THE 1 INPUT PROCESSES ARE 44.

THE 1 CUTFUT PROCESSES ARE 32.

OUTPUT SCHEME O IS USED

\*O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.

INITIALLY, THERE ARE O ITEMS BEING PROCESSED.

THE INITIAL PROCESS STATUS IS OPEN

```
PROCESS 11 *** LANCING/SAFING
   IT IS LOCATED AT POSITION 351 CF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS.
        1.00.
                  9.60
                            C.00.
                                      0.00.
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE 52.
 THE 1 OUTPUT PROCESSES ARE 13.
   OUTPUT SCHEME O IS USED
  5 ITEMS CAN BE PROCESSED SIMULTANECUSLY.
  INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
PROCESS 13 *** PAYLOAD REMOVAL/SHUTTLE MAINTEN. ***
  IT IS LOCATED AT POSITION 332 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 34 HAS 7 DESCRIPTORS.
        1.00, 60.80, 0.00, 1.00, 10.00, 0.00,
                                                                     0.00.
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE 11.
 THE 2 OUTPUT PROCESSES ARE 19,
   DUTPUT SCHEME 11 IS USED
  1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
PROCESS 15 *** SRU REWORK
 ACTIVITY COST TRANSFORMATION 5 HAS 2 DESCRIPTORS.
   REFER TO THE FROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  IT IS LOCATED AT POSITION 547 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 46 HAS 4 DESCRIPTORS.
              .00, C.OC, 0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE
 THE I DUTFUT PROCESSES ARE 197,
   GUTPUT SCHEME O IS USED
 *O ITEMS CAN BE PROCESSED SIMILTANEOUSLY.
 INITIALLY. THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS SPECIAL
```

```
PROCESS 19 *** PREMATE PREP/PAYLOAD INSTALL
  IT IS LOCATED AT POSITION 203 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 32 HAS 8 DESCRIPTORS.
                730.00.
                            C.OC. C.CO. 0.00.
                                                         0.00.
                                                                   0.00.
                                                                             0.00.
        1.00.
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 3 INPUT PROCESSES ARE 13, 32, 31,
 THE 1 OUTPUT PROCESSES ARE 24.
   OUTPUT SCHEME O IS USED
  5 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS SPECIAL
PROCESS 24 *** SHUTTLE ASSEMBLY
  IT IS LOCATED AT POSITION BEL OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS.
                            0.00,
                  0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE . 19.
 THE 1 OUTPUT PROCESSES ARE 27,
 . OUTPUT SCHEME O IS USED
  1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS UPEN
PROCESS 27 *** LAUNCH
 ACTIVITY COST TRANSFORMATION 6 HAS 13 DESCRIPTORS.
    13006.00, 264.86, 3200.00, 890.91, 3200.00, 280.00, 3200.00, 1113.64, 3200.00,
      280.00.
               6000.00, 1113.64, 6CCC.CO,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  IT IS LOCATED AT POSITION 396 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS.
        1.00.
                  0.00.
                            C. GC.
                                     0.00.
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE . VALUES.
 THE 1 INPUT PROCESSES ARE 24.
 THE 1 OUTFUT PROCESSES ARE 39.
   BUTPUT SCHEME O IS USED
  1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
```

### THE INITIAL PROCESS STATUS IS CHEN

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PROCESS 30 *** SRU PAYLOAD HOLD/RELEASE _
   IT IS LOCATED AT POSITION SO OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 40 HAS 2 DESCRIPTORS.
        0.00.
                0.00.
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE 42.
  THE 1 OUTPUT PROCESSES ARE 19.
    CUTPUT SCHEME 2 IS USED
  *O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATLS IS CPEN
PROCESS 31 *** DUMMY INSERT SHLTTLES ***
   IT IS LOCATED AT POSITION 224 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS.
       -0.00, -0.00, -0.00, -0.00,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE -1,
o THE 1 OUTPUT PROCESSES ARE 19,
    DUTPUT SCHEME O IS USED
  4 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE 4 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS CLOSED
 PROCESS 32 *** SATELLITE HOLD/RELEASE ***
   IT IS LOCATED AT PUSITION 512 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 35 HAS 5 DESCRIPTORS.
        0.00, 0.00, 0.00, 0.00,
                                           0.00,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 3 INPUT PROCESSES ARE 1, 10, 3,
  THE 1 DUTPUT PROCESSES ARE 19,
    CUTPUT SCHEME 2 IS USED
   O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY. THERE ARE O ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS UPEN
```

```
PROCESS 39 *** LAUNCH INTO CRRIT
  IT IS LOCATED AT POSITION 239 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 33 HAS 9 DESCRIPTORS.
       1.00, .00, C.OC, 1.00, 0.0C, 0.00, 2.00, 0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE I INPUT PROCESSES ARE 27.
 THE 5 OUTFUT PROCESSES ARE 199, 52, 45, 45, 45,
  CUTPUT SCHEME 10 IS USED
  1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
PROCESS 42 *** SRU REPLACEMENT
  IT IS LOCATED AT POSITION 530 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 37 HAS 5 DESCRIPTORS.
       1.00.
                         C.00, -1.00, C.00,
                 .00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE 2.
 THE 2 OUTFUT PROCESSES ARE 30, 2,
  OUTPUT SCHEME 14 IS USED
 *O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE O ITEMS BEING FROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
PROCESS 44 *** SPACECRAFT EQUIP. MFG
 ACTIVITY COST TRANSFERMATION 5 HAS 2 DESCRIPTORS.
     2005.00.
                 .64,
 PEFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 IT IS LOCATED AT POSITION 465 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 37 HAS 12 DESCRIPTORS.
            .00, G.OC, 8.00, 1.00,
       1.00.
                                                     2.00, 3.00,
      11.00. 13.60.
                         21.00.
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE 1.
 THE 1 OUTFUT PROCESSES ARE 10,
   QUIPUT SCHEME O IS USED
 *O ITEMS CAN BE PROCESSED SIMILTANEOUSLY.
 INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATLS IS OPEN
```

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PROCESS 45 *** SHUTTLE/SATELLITE DISENGAGEMENT ***
  IT IS LOCATED AT POSITION 279 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 33 HAS 10 DESCRIPTORS.
                                         0.00, 0.00, 3.00, 0.00,
       1.00,
                 .00, 6.00, 2.00,
       0.00.
 REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE 39.
 THE 9 OUTFLT PROCESSES ARE 52, 191, 192, 65, 192, 191, 52, 65, 66,
   OUTPUT SCHEME 10 IS USED
  1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
PROCESS 52 *** RETURN FROM CRBIT
  IT IS LOCATED AT POSITION 263 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS.
       1.00, 8.00, 0.00, 0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 2 INPUT PROCESSES ARE 35. 45.
 THE 1 DUTPUT PROCESSES ARE 11.
  OUTPUT SCHEME O IS USED
  1 ITEMS CAN BE PROCESSED SIMULTANECUSLY.
 INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
PROCESS 65 *** SATELLITE IN CREIT ***
  IT IS LOCATED AT POSITION 126 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 36 HAS 10 DESCRIPTORS.
                0.00, C.OC, 1.00, 1.00, 0.00, 0.00, 0.00, C.OC,
    £7600.00.
       0.00.
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE 45.
 THE 4 OUTFUT PROCESSES ARE 65, 190, 193, 104,
  CLTPUT SCHEME 12 1S USED
  1 ITEMS CAN BE PROCESSED SIMILTANEOUSLY.
 INITIALLY. THERE ARE O TTEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
```

```
PROCESS 66 *** REPLACE SRU IN SPACE ***
   IT IS LOCATED AT POSITION 47 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 27 HAS 2 DESCRIPTORS.
        .00, 65.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE 45.
  THE 1 DUTPUT PROCESSES ARE 52.
   OUTPUT SCHEME O IS USED
   1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN
PROCESS 79 *** GENERAL ORDER INSERTION ***
   IT IS LOCATED AT POSITION 565 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS.
       0.00, 0.00, 0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE -1.
O THE 1 OUTFUT PROCESSES ARE 1,
   OUTPUT SCHEME O IS USED
  1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 1 ITEMS CAN BE PROCESSED SIMILIANEUCOLIO
INITIALLY, THERE ARE 1 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS CLOSED
PROCESS 103 *** DECISION MAKING ACTIVITY ***
  IT IS LOCATED AT POSITION 150 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 2 HAS 4 DESCRIPTORS.
               C.CC, C.CO,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 3 INPUT PRUCESSES ARE 195, 151, 190,
  THE 1 OUTFUT PROCESSES ARE 2.
  #O ITEMS CAN BE PROCESSED SIMILTANEOUSLY.
  INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN
PROCESS 104 *** ORBITAL OPER. PYLD
  IT IS LOCATED AT POSITION 111 OF THE INTERNAL COMPUTER LIST AREA.
```

PROCESS TRANSFORMATION TYPE 1 FAS 4 DESCRIPTORS.

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1.00. 0.00. C.CC. 0.CO.
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
   THE 1 INPUT PROCESSES ARE 65,
   THE 1 GUTPUT PROCESSES ARE 2.
    OUTPUT SCHEME O IS LSED
   *O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
   INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
   THE INITIAL PROCESS STATUS IS OPEN
 PROCESS 190 *** FAILURE SATELLITE IN CRBIT ***
    IT IS LOCATED AT POSITION 451 OF THE INTERNAL COMPUTER LIST AREA.
   PROCESS TRANSFORMATION TYPE 29 HAS 1 DESCRIPTORS.
         5.00.
     REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
   THE 3 INPUT PROCESSES ARE 65, -1, -1,
   THE 1 OUTFUT PROCESSES ARE 103,
   DUTPUT SCHEME O IS USED
   *O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
   INITIALLY. THERE ARE O ITEMS BEING PROCESSED.
   THE INITIAL PROCESS STATUS IS OPEN
L PROCESS 191 *** SATELLITE LOST DISENGAGEMENT ***
    IT IS LOCATED AT POSITION 425 OF THE INTERNAL COMPUTER LIST AREA.
   PROCESS TRANSFORMATION TYPE 29 HAS 1 DESCRIPTORS.
         2.00.
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
   THE 1 INPUT PROCESSES ARE 45.
   THE 1 OUTFUT PROCESSES ARE 103.
   CLTPUT SCHËME C IS LSED
   *O ITEMS CAN BE PROCESSED SIMULTANEOLSLY.
   INITIALLY. THERE ARE O ITEMS BEING PROCESSED.
   THE INITIAL PROCESS STATUS IS CHEN
 PROCESS 192 *** SHUTTLE LOST DISENGAGEMENT ***
   IT IS LOCATED AT POSITION 308 OF THE INTERNAL COMPUTER LIST AREA.
   PROCESS TRANSFORMATION TYPE 29 HAS 1 DESCRIPTORS.
        1.00.
     REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
   THE 1 INPUT PROCESSES ARE 45.
```

```
THE 1 DUTPUT PRICESSES ARE -1.
     OUTPUT SCHEME O IS USED
   *O ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
   INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
   THE INITIAL PROCESS STATUS IS OPEN
 PROCESS 193 *** END OF MISSION
    IT IS LOCATED AT POSITION 437 OF THE INTERNAL COMPUTER LIST AREA.
   PROCESS TRANSFORMATION TYPE 29 HAS 1 DESCRIPTORS.
         7.00.
     REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
   THE 3 INPUT PROCESSES ARE 65, -1, -1,
   THE 1 DUTPUT PROCESSES ARE -1,
     OUTPUT SCHEME O IS USED
   *O ITEMS CAN BE PROCESSED SIMULTANEGUSLY.
   INITIALLY, THERE ARE C ITEMS BEING PROCESSED.
   THE INITIAL PROCESS STATUS IS OPEN
FPROCESS 197 *** COLLECTION OF RETURNS
   IT IS LOCATED AT POSITION 60 OF THE INTERNAL COMPUTER LIST AREA.
   PROCESS TRANSFORMATION TYPE 25 HAS 1 DESCRIPTORS.
         7.00.
     REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
   THE 1 INPUT PROCESSES ARE 15.
 THE 1 OUTPUT PROCESSES ARE -1.
    CUTPUT SCHËME O IS USED
   *O ITEMS CAN BE PROCESSED SIMULTANECUSLY.
   INITIALLY, THERE ARE O ITEMS BEING PROCESSED.
   THE INITIAL PROCESS STATUS IS OPEN
 PROCESS 198 *** SATELLITE RETRIEVAL
    IT IS LOCATED AT POSITION . 1 OF THE INTERNAL COMPUTER LIST AREA.
   PROCESS TRANSFORMATION TYPE 25 HAS I DESCRIPTORS.
     REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
   THE 1 INPUT PROCESSES ARE 5.
   THE 1 OUTPUT PRICESSES ARE
    OUTPUT SCHEME O IS USED
```

PROCESS 199 \*\*\* SHUTTLE LOST LAUNCH \*\*\*

IT IS LOCATED AT POSITION 320 CF THE INTERNAL COMPUTER LIST AREA.

PROCESS TRANSFORMATION TYPE 25 HAS 1 DESCRIPTORS.

3.0C,

REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.

THE 1 INPUT PROCESSES ARE 39,

THE 1 OUTPUT PROCESSES ARE 103,

CUTPUT SCHEME 0 IS USED

\*0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.

INITIALLY, THERE ARE 0 ITEMS BEING PROCESSED.

THE INITIAL PROCESS STATUS IS OPEN

INITIALLY, THERE ARE C ITEMS BEING PROCESSED.

### \*\*\*\*\* SHUTTLE/SATELLITE/UNIT DISPOSITION AT START \*\*\*\*\*

THE ORDER 80001 IS SCHEDULED TO LEAVE PROCESS 79 AT 0.000 HOURS.

THE SHUTTLE #0001 IS SCHEDULED TO LEAVE PROCESS 31 AT 0.000 HOURS. THERE IS NO PAYLOAD ABOARD

THE SHUTTLE \*0002 IS SCHEDULED TO LEAVE PROCESS 31 AT 0.000 HOURS. THERE IS NO PAYLOAD ABOARD

THE SHUTTLE #0003 IS SCHEDULED TO LEAVE PROCESS 31 AT C.OOC HOURS. THERE IS NO PAYLOAD ABOARD

THE SHUTTLE \*COO4 IS SCHEDULED TO LEAVE PROCESS 31 AT 0.000 HOURS. THERE IS NO PAYLDAD AUDARD

SRU	SOL	AR ARRAYAER	IVE MOD	ULE		•	
MODEL 1	SRU EQUIV.	1 WEIGHT	237	NC. OF	COMP. 12		
TYPE	ALPFA	BETA	CONDI	TICN	DSGN LIFE	COMP. NAME	COST(CGLLARS)
	*CCCCCCOOO.	1.0000	ACTIVE	1.00	*CCCCO.	AC STR	92000.00 MFG.
10603.01		1.0000	ACTIVE	1.00	*00000.	THER	12000.00 MFG.
10651.03	A delication and the contract of the contract	1.0000	ACTIVE	1.00	<b>*00000.</b>	A DRIV	45000.00 MFG.
10651.03	· ·	1.0000	STNEBY	.10	*CC00C.	A DRIV	45000.00 MFG.
10652.03		1.000C	ACTIVE	1.00	<b>*</b> 00000.	AC ELE	30000.00 MFG.
10652.03		1.00GC	STREBY	-10	*00000.	AD ELE .	30000.00 MFG.
10631.02		1.0000	ACTIVE	1.00	*OCCCO.	DI/SCU	22000.00 PFG.
10631.02		1.0000	STNDBY		*CCOCO.	DI/SCU	22000.00 MFG.
10611.03	* ***	1.0000	ACTIVE		*00000.	AD PCU	25000.00 MFG.
10611.03		1.000C	STNEBY	-10	*CCCCO.	AD PCU	25000.00 MFG.
10653.03	*CCCCCGGOO.	1.000C	ACTIVE	1.00	*0000C.	ARRAY	528000.00 PFG.
UILD COST	*CCCCCCCO.	1.0000	ACTIVE		*00000. MFG. 1.2	HARN 8 BUY 1-11	10000.00 MFG.
	.0250 MILL		S	FACTORS	Company of 11 and in representation in agreement in the company		10000.00 MFG.
RU	.0250 MILL	TEN DELLAR	S (	FACTORS	Company of 11 and in representation in agreement in the company		10000.00 MFG.
UILD COST	.0250 MILL	TEN DELLAR	S (	FACTORS	MFG. 1.2		COST(DOLLARS)
UILD COST  RU  ODEL 2  TYPE	.0250 MILL	TEN DELLAR  CTRIC POWE  NEIGHT  BETA	S I F MCCULI 440 CGNDII	FACTORS  NC. OF	MFG. 1.2  CCMP. 12  DSGN LIFE	8 BUY 1.11	COST(DOLLARS)
UILD COST  RU  ODEL 2  TYPE	.0250 MILL ELE SRL EQUIV. ALPHA	TEN DELLAR	F MCCULI  440  CGNDII	FACTORS  NC. OF  TICN  1.00	MFG. 1.2  CCMP. 12  DSGN LIFE  *OCCCG.	COMP. NAME	COST(DOLLARS) 19600.00 MFG.
UILD COST  RU  ODEL 2  TYPE  10301.03	.0250 MILL SRL EQUIV. ALPHA *CCCCCCOOOO.	TEN DELLAR  CTRIC PEWER  MEIGHT  BETA  1.0000 1.0000	F MCCULI  440  CGNDII  ACTIVE  ACTIVE	FACTORS  NC. OF  TICN  1.00  1.00	MFG. 1.2  CCMP. 12  DSGN LIFE  *OCCCG. *OGGCG.	COMP. NAME EP STR THERM	COST(DOLLARS)  19600.00 MFG. 18000.00 MFG.
UILD COST  RU  ODEL 2  TYPE  10301.03 10303.01	JO250 MILL SRL EQUIV. ALPHA *CCCCCCCCC.	TEN DELLAR  CTRIC PEWER  MEIGHT  BETA  1.0000	F MCCULI  440  CONDIT  ACTIVE ACTIVE ACTIVE	ACTORS  NC. OF  TICN  1.00  1.00  1.00	MFG. 1.2  CCMP. 12  DSGN LIFE  *OCCCO. *OGCCO. *CCCCOO.	CCMP. NAME EP STR THERM EP PCU	COST(DOLLARS)  19600.00 MFG. 18000.00 MFG. 25000.00 MFG.
UILD COST  RU  ODEL 2  TYPE  10301.03 10303.01 10311.03	*CCCCCOOO 4CCCOO	LIEN DELLAR  CTRIC PEWER  MEIGHT  BETA  1.0000  1.0000	F MCCULI  440  CONDIT  ACTIVE ACTIVE ACTIVE STNEBY	NC. OF IIIN 1.00 1.00 1.00 1.00	MFG. 1.2  CCMP. 12  DSGN LIFE  *OCCCO. *CCCCO. *CCCCO.	CCMP. NAME  EP STR THERM  EP PCU  EP PCU	COST(DULLARS)  19600.00 MFG. 18000.00 MFG. 25000.00 MFG. 25000.00 MFG.
UILD COST  RU  ODEL 2  TYPE  10301.03 10303.01 10311.03 10311.03	*CCCCCOOO . 1CCCCOOO . 4CCOO .	LEN DELLAR  CTRIC PEWER  MEIGHT  BETA  1.0000 1.000C 1.000C	F MCCULI  440  CONDIT  ACTIVE ACTIVE ACTIVE	NC. OF IIIN 1.00 1.00 1.00 1.00 .10 .10	MFG. 1.2  CCMP. 12  DSGN LIFE  *0CCCG. *CCCGO. *CCCGO. *CCCGO. *CCCGO.	COMP. NAME  EP STR THERM  EP PCU  EP PCU  DI/SCU	COST(DOLLARS)  19600.00 MFG. 18000.00 MFG. 25000.00 MFG. 25000.00 MFG. 39000.00 MFG.
UILD COST  RU  ODEL 2  TYPE  10301.03 10303.01 10311.03 10311.03 10331.01	*CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC	TEN DELLAR  CTRIC PEWER  MEIGHT  BETA  1.0000 1.0000 1.0000 1.0000	F MCCULI  440  CGNDIT  ACTIVE  ACTIVE  ACTIVE  STNEBY  STNEBY	FACTORS  NC. OF  IIIN  1.00  1.00  1.00  .10  .10  1.00	MFG. 1.2  CCMP. 12  DSGN LIFE  *0CCCG. *0CCCG. *CCCCO. *CCCCO. *CCCCO.	COMP. NAME  EP STR THERM EP PCU EP PCU DI/SCU	COST(DOLLARS)  19600.00 MFG. 18000.00 MFG. 25000.00 MFG. 25000.00 MFG. 39000.00 MFG.
UILD COST  RU  ODEL 2  TYPE  10301.03 10303.01 10311.03 10311.03 10331.01	*CCCCCOOOO 4CCCOO 4CCCOO 218341 218341	TEN DELLAR  CTRIC PEWER  NEICHT  BETA  1.0000 1.0000 1.0000 1.0000 1.0000	F MCCULI  440  CGNDI  ACTIVE ACTIVE ACTIVE STNEBY STNEBY ACTIVE ACTIVE	FACTORS  NC. OF  IIIN  1.00 1.00 1.00 1.00 1.00 1.00	MFG. 1.2  CCMP. 12  DSGN LIFE  *0CCCG. *0CCCG. *CCCCG. *CCCCG. *CCCCG. *CCCCG.	COMP. NAME  EP STR THERM EP PCU EP PCU DI/SCU DI/SCU PCNTRL	COST(DOLLARS)  19600.00 MFG. 18000.00 MFG. 25000.00 MFG. 25000.00 MFG. 39000.00 MFG. 39000.00 MFG.
ODEL 2  TYPE  10301.03 10303.01 10311.03 10311.03 10331.01 10331.01 10351.03	*CCCCCOOOO .  1CCCCCOOO .  4CCOO .  4CCOO .  218341 218341 125COOC	IEN DELLAR  ECTRIC PEWER  1 WEIGHT  BETA  1.0000 1.0000 1.0000 1.0000 1.0000 1.0000	F MCCULI  440  CGNDII  ACTIVE ACTIVE ACTIVE STNEBY ACTIVE	FACTORS  NC. OF  IIIN  1.00 1.00 1.00 1.00 1.00 1.00 1.00	MFG. 1.2  CCMP. 12  DSGN LIFE  *0CCCG. *0CCCG. *CCCCO. *CCCCO. *CCCCO.	COMP. NAME  EP STR THERM EP PCU EP PCU DI/SCU	COST(DOLLARS)  19600.00 MFG. 18000.00 MFG. 25000.00 MFG. 25000.00 MFG. 39000.00 MFG.

1754386 1.000C ACTIVE 1.00 \*00000a 28800.00 BUY 10391.03 \*0CCC00000. 17000.00 MFG. 1.0000 ACTIVE 1.00 \*0000C. HARN BUILD COST .0300 MILLION DOLLARS FACTORS MFG. 1.29 BUY 1.12 SRU -OM≠D AND CATA HANDLING MODULE MODEL SRU ECUIV. WEIGHT 194 NG. OF COMP. 25 TYPE ALPHA BETA CONDITION DSGN LIFE COMP. NAME COST( DOLLARS) 10201.03 \*CCCCCC000. 1.0000 ACTIVE 1.00 \*00000a CD STR 19600.00 MFG. 10203.01 100000000 1.0000 ACTIVE 1.00 \*000C0. THERM 13900.00 MFG. 10256.C2 50000000 1.0000 \*00000a ACTIVE 1.00 CMN I 20000.00 BUY 10252.02 565480 1.0000 \*00CCO. XMTR ACTIVE 1.00 43000-00 BUY 10252.02 -585480 1.0000 STNOBY .10 **\*000000.** XMTR 43000.00 BUY 10251.02 248694 1.0000 ACTIVE 1.00 \*000000-RCVR 65000.00 BUY 10251.02 248694 1.0000 \*OCCCO. ACTIVE 1.CO RCVR 65000.00 BUY 833333 10253.02 1.0000 ACTIVE 1.00 \*00000. DIPLXR 32000.00 BUY 10273.02 2159827 1.0000 ACTIVE 1.00 \*00000. DECOD 30000.00 MFG. 10273.02 2159827 1.0000 \*CCCCC. ACTIVE -1.CO DECODER 30000.00 MFG. 10274.02 273823 1.CCCC ACTIVE 1.00 **\*00000**. BUSCEN 20000.00 MFG. 1.0000 10274.02 273823 STNEBY .10 \*00000. BUSCON 20000.00 MFG. 10255.02 871840 1.0000 \*OCCOC. ACTIVE 1.00 BB ASY 12000.00 MFG. 10255.02 £71840 1.0000 STNEBY .10 \*CCCCC. BB ASY 12000.00 MFG. 10211.02 400000 1.0000 ACTIVE 1.00 \*00000a PCU 25000.00 MFG. 10211.02 400000 1.0000 ACTIVE 1.00 **\*000000**. PCU 25000.00 MFC. ACTIVE 1.00 10254.02 4166667 1.0000 \*OCCCO. CMBSW -6500.00 BUY 10271.02 142857 1.0000 ACTIVE 1.00 **\*00000.** CPU 45000.00 BUY 10271.02 1.0000 CPU 142857 STNDBY .10 \*000000. 45000.00 BUY 20272.02 1.0000 ACTIVE 1.00 \*CCCCCa. 291630 MEM L 35000.00 BUY 20272.02 291630 1.0000 ACTIVE 1.CO \*000CC. MEM L 3500C.00 BUY 20272.02 1.0000 29163C STNDBY .10 \*0C000. MEM U 35000.00 BUY 22000.00 MFG. 10231.02 25274C 1.0000 ACTIVE 1.00 **\*000000**. DIVSCU 10231.02 292740 1.0000 STNDBY .10 \*GCCCCO. DI/SCL 22000.00 MFG. 10291.02 \*CCCCCC000. 1.0000 ACTIVE 1.CO \*C0C00. HARN 15000.00 MFG. .0900 MILLION COLLARS . FACTORS MFG. 1.29 BUY 1.12 BUILC COST

. <b>M</b> i	ODEL 4	SRU EQUIV.	1 WEIGHT	257 NO. OF	COMP. 24	•	
	TYPE	ALPHA	8ETA .	CONDITION	DSGN LIFE	COPP. NAME	COST ( DOLL ARS )
	16401 02	*ccccc0000.	1.0000	ACTIVE 1.00	*00000.	AD STR	19600.00 MFG.
	10403.01	100000000	1.0000	ACTIVE 1.00	*000 <b>00</b> •	THERM	18000.00 MFG.
	30451.02	55945	1.00CC	ACTIVE 1.00	*CCCCO.	GRA	80000-00 BUY
	30451.02	59945	1.0000	ACTIVE 1.00	*00000.	GRA	8000C.00 BUY
	30451.02	59945	1.0000	ACTIVE 1.00	*00000*	GRA	80000.0C BUY
	30451.02	59945	1.0000	STNEBY .10	*00000.	GRA	8000C.OC BUY
	30451.02		1.0000	STNDBY .10	*0C000.	GRA	80000.00 BUY
	30451.02	59945	1.0000	STNEBY .10	*00000-	GRA	80000.00 BUY
	20452.01	190259	1.0000	ACTIVE 1.CO	*GCCCC.	STAR T	69000.00 BUY
	20452.01	190259	1.0000	STNOBY .10	*0000C.	STAR T	69000.00 BUY
	20452.01	190259	1.0000	ACTIVE 1.00	<b>*00000</b> .	STAR T	69000.00 BUY
	10453.02	714286	1.000C	ACTIVE 1.00	*00000.	MAGN	20000.00 BUY
	10453.02	714286	1.000C	STNDBY .10	<b>*00000.</b>	MAGN	20000.00 BUY
	10454.00	12500000	1.0000	ACTIVE 1.CO	*00000.	SUN	44000.00 BUY
ျှ ဂု	10471.02	- 105263	1.0000	ACTIVE 1.00	*00000.	XFER A	27500.00 MFG.
16	10471.02	105263	1.0000	STNDBY .10	*0C000.	XFER A	27500.00 MFG.
Ŭ.	10472.01	105263	1.0000	ACTIVE 1.00	*00000 <b>.</b>	XFER 8	27500.00 MFG.
	10472.01	105263	1.CCOC	STNCBY .10	<b>*00000.</b>	XFER B	27500.00 MFG.
	10473.00	2873563	1.0000	ACTIVE 1.00	<b>*80000.</b>	SAF MD	7000.00 MFG.
	10411.03	400000	1.0000	ACTIVE 1.00	<b>*00000</b> .	PCU	25000.00 MFG.
	10411.03	400000	1.0000	STNCBY .10	*CCC00.	PCU	25000.00 MFG.
	10431.02	215889	1.0000	ACTIVE 1.00	*000C0.	DI/SCU	56000.00 MFG.
	10431.02	215889	1.0000	STNEBY . 10	*000C0.	DI/SCU	56000.00 MFG.
		*OCCCCOCC.	1.0000	ACTIVE 1.00	<b>*00000.</b>	HARN	16000.00 MFG.
Ri	UILD COST	-C900 MILL	LION DOLLAR!	FACTORS	MEG 1.2	9 BUY 1.12	
<u></u>	OILD COST				/ <u>%</u> <del></del>		
S	RU	AC TI	UATION MCCUI	. <b>F</b>			•
					,		-
M	ODEL 5	SRU ECUIV.	1 WEIGHT	127¢ NG. OF	COMP. 21		<u>:</u>
<b></b>	TYPE	ALPHA	BETA	CCNDITICN	US GN LIFE	COMP. NAME	COST(DOLLARS)
	10501 - 03	*cccc00000.	1.0000	ACTIVE 1.00	*00000.	STRUC	24000.00 MFG.
	10503.01	10000000	1.0000	ACTIVE 1.00	*00000.	THERM	18000.00 MFG.
	10504.02		1.0000	ACTIVE 1.CO	<b>*00000.</b>	PTHER	11500.00 MFG.

10551.01	666667	1.0000	ACTIVE 1.00	*00000.	RRiv	52000.00 BUY	
10552.01	6666667	1.0000	ACTIVE 1.00	<b>*</b> 00000.	PRW	52000.00 BUY	
10553.01	666667	1.0000	ACTIVE 1.00	*CCCCC.	YR₩	52000.00 BUY	
10571.01	309119	1.000C	ACTIVE 1.CO	*00C00.	R₩ EL	26000.00 MFG.	
10571.01	369119	1.0000	STACBY .10	*00000.	R₩ EL	26000.00 MFG.	. 11
10572.01	309119	1.0000	ACTIVE 1.00	*00000-	PW EL	26000.00 MFG.	
10572.01	309119	1.0000	STNCBY .10	*C0000.	PW EL	26000.00 MFG.	
10573.01	369119	1.0000	ACTIVE 1.00	*00CCO.	YW EL	26000.00 MFG.	
10573.01	309119	1.000C	STNEBY .10	*00000.	YW EL	26000.00 MFG.	•
10554.01	10000000	1.0000	ACTIVE 1.00	*CCCCO.	RMT .	8000.0C MFG.	
10555.01	1000000C	1.0000	ACTIVE 1.00	*CCC00.	PMT	8000.00 MFG.	
10556.01	10000000	1.0000	ACTIVE 1.00	*00000.	YMT	8000.00 MFG.	
10574.01	370370	1.0000	ACTIVE 1.00	*000CD.	MT EL	25000.0G MFG.	
10531.02	215889	1.0000	ACTIVE 1.00	*CCCCO.	DI/SCU	42000.00 MFG.	
10531.02	215889	1.0000	STNDBY .10	*CCCCO.	DI/SCU	42000.00 MFG.	
10557.03	83333333	1.0000	ACTIVE 1.00	*00000.	G N 2	245000.00 MFG.	
10558.02	2923977	1.0000	ACTIVE 1.00	*000C0.	N2H4	175000.00 MFG.	
16591.03		1.0000	ACTIVE 1.00	*C0C00.	HARN	16000.00 MFG.	
င့					•		
BUILD COST	.0450 MILL	ICN DELLA	PS FACTORS	MFG. 1	.32 EUY 1.50		

		 				a con all and a second	The second second second	
SR	U	 	FΙ	VE 1	AND	MSS	NP)	KR-A

1321004

1321004

1321004

1.0000

1.0COC

1-0000

ACTIVE 1.00

ACTIVE 1.00

ACTIVE 1.00

40552.01

40952.01

40553.01

MODEL	11	SRU	ECUIV.	_1_	WEIGHT	276	NO. OF	COMP. 26			·
	TYPE		ALPHA		BETA	CONDI	TIEN	DSGN LIFE	COMP. NAME	COST(DOLLARS)	
10 93	1.01		207900		1.000C	ACTIVE	1.00	*00000.	MPXR	712000.00 BUY	
4095	1.01	•	1321004		1.0000	ACTIVE	1.00	*00000.	BND1	111000-00 8UY	
4095	1.01		1321004		1.0000	ACTIVE	1.00	*00000.	BND1	111000.00 EUY	
4055	1.01		1321004		1.CCOC	ACTIVE	1.00	*00000.	enc1	111000.00 EUY	
4( 95	1.01		1321004		1.0000	ACTIVE	1.00	*00CCO.	BND1	111000.00 BLY	
4095	1.01		1321004		1.0000	ACTIVE	1.00	*COCCC.	BND1	111000.00 BUY	
4055	1.01	···	1321004		1.0000	ACTIVE	1.00	*00000.	BNC1	111000.00 BUY	
4( 95	2.01		1321004		1.0000	ACTIVE	1.00	*00 <b>00</b> 0.	BND 2	111000.00 BUY	
4055	2.01		1321004	-	1.0000	ACTIVE	1.00	*OCCCO.	BND2	111000.0C BLY	
4055	2.01		1321004		1.0CGC	ACTIVE	1.00	*00C00.	BND2	111000.00 BUY	
4655	2.01		1321004		1.0000	ACTIVE	1.00	*00000.	BND2	111000.00 BUY	
,,,,	3 01		1221007								

\*OCCOC.

\*CCCOO.

\*00000.

BND2

BNDZ

BND3

111000.00 BLY

111000.00 BUY

111000.00 BUY

40 553. 01	1321004	1-0000	ACTIVE 1.00	<b>*00000</b> .	BND3	111000-00 BUY	
40553.01	1321004	1.0000	ACTIVE 1.CO	*00CC0.	BND3	111000.00 BUY	·
40553.01	1321004	1.0000	ACTIVE 1.00	<b>*00000.</b>	BND3	111000.00 BUY	
40553.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND3	111000.00 BUY	
4(553.01	1321004	1.0000	ACTIVE 1.00	*OCCCC.	BND3	111000.00 BUY	4.44
40554.01	1321004	1.0000	ACTIVE 1.CO	*00000.	BND4	1110G0.00 BUY	
40954.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND4	111000.00 BUY	-
4(554.01	1321004	1.0000	ACTIVE 1.00	*0C000.	BND4	111000.00 BUY	
40954.01	1221004	1.0000	ACTIVE 1.00	*00000.	BND4	111000.00 BUY	
40554.01	1221004	1.0000	ACTIVE 1.00	*00C00.	BND4	111000.00 BUY	-
40954.01	1321004	1.0000	ACTIVE 1.CO	*0C000.	BND4	111000.00 BUY	+ 3-
10955.01	460405	1.0000	ACTIVE 1.00	*00000.	BND 5	324000.00 BUY	•

BUILE COST .0300 MILLICN DOLLARS FACTORS MFG. 1.29 BLY 1.12

-----WIDEBAND CON MCDULE A

MODEL 13 SRL EGUIV. 1 WEIGHT 329 NC. OF COMF. 12

Ω	TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)	
-18	10831.01	13157895	1.000C	ACTIVE 1.CO	*0CC00.	HSMPX	3700.00 MFG.	
•	10832.01	677966	1.0000	ACTIVE 1.00	*00000.	DATA PROCESSOR	72000.00 MFG.	
	10852.01	2702703	1.0000	ACTIVE 1.00	<b>*00000.</b>	P AMP	18100.00 MFG.	•
	10853.01	9615385	1.0000	ACTIVE 1.00	*CCCCO.	ANTEN	5100.00 MFG.	
	50854.01	2 <b>6</b> 315789	1.0000	ACTIVE 1.00	*0CCCO.	DATA CH	1900.00 MFG.	
	5(854.01	<u> 26315789</u>	1.0000	ACTIVE 1.CÓ	*00000.	DATA CH	1900.00 MFG.	
	50854.01	· 26315789	1.0000	ACTIVE 1.CO	<b>*00000.</b>	DATA CH	1900.00 MFG.	
	5CE54.01	26315789	1.0000	ACTIVE 1.00	<b>*</b> 00000.	DATA CH	1900.00 MFG.	
	50854.01	26315789	1.0000	ACTIVE 1.00	*0000Q.	DATA CH	1900.00 MFG.	
	50854.01	26315789	1.0000	ACTIVE 1.00	*OCCC.	DATA CH	1900.00 MFG.	
	10731.01	181818	1.0066	ACTIVE 1.00	<b>#80000.</b>	VTR	4000C0.0C BUY	
	10731.01	181818	1.0000	STNDBY .10	<b>‡00000.</b>	VTR	400000.00 BUY	

BUILD COST .0300 MILLION DELLARS FACTORS MFG. 1.29 BUY 1.12

NRU

----NON-REPLACEABLE COMPONENTS

MODEL 21 SRU EQUIV. 1 WEIGHT 593 NO. OF COMP. 9

		·					
			,				
	TYPE ALPHA	BETA	CCNDITICN	DSGN LIFE	COMP. NAME	COSTLOOLLARS)	<u>.</u>
	10CC1.C2 *CCCCCCCOO.	1.0000	ACTIVE 1.00	*0C000.	STRUCT	88900.00 MFG.	
	10C02.01 *CCCCCCCCO.	1.0000	ACTIVE 1.00	*000C0.	PL STRUCTURE	287000.00 MFG.	
	10041.02 *CCCCCCCOC.	1.0006	ACTIVE 1.00	*CCC00.	TRING	7600.00 MFC.	11.4.44
	10061.01 *000000000.	1.0000	ACTIVE 1.00	*00000.	ACAPT.	25200.00 MFG.	, 6
	_10071.C2 *CCCCCCCOO.	1.0000	ACTIVE 1.00	*OCCCO.	MECHANISMS	16100.00 MFG.	
C	10C03.01 *C0CCC0C00.	1.0000	ACTIVE 1.00	*0CC00.	SC THERMAL	118000.00 MFG.	*
<u>.</u>	10C21.01 *CCCCCCCO.	1.0000	ACTIVE 1.00	<b>*00000.</b>	PL THERMAL	233000.00 MFG.	
9	10091.02 *C000000000.	1.0000	ACTIVE 1.00	*CC000.	SC HARNESS	10000.00 MFG.	
•	10081.01 *C00000000.	1.0000	ACTIVE 1.00	*C0C00.	PL HARNESS	10000.00 MFG.	•
Bil	ILC COST .0600 MILL	TON DOLLAR	£				
_ U.	ILL COST . GOOD FILE	ICN DOLLAR	FACTURS	, MFG. 1.2	8 BUY 1.11		

# \*\*\*\* TIME LINE ANALYSIS DESCRIFTION \*\*\*\*

									•						100		
	THER	E IS NO TI	ME LIN	E ANALY	SIS INPL	T										,	1
	ITEM	40000004					AT	0.000	HOURS	•							
	ITEM	30000003	ENTER	ED PROC		19			<b>FOURS</b>						<del></del>	· · · · · · · · · · · · · · · · · · ·	
	ITEM	20000002	ENTER	ED PROC		19			HOURS							•	
.,	ITEM	10000001	ENTER	EC PROC		19			HOURS								
	ITÈM	80001	ENTER	ED PRCC	ESS	1	AT		HOURS								
	ITEM	80001	ENTER	ED PROC	ESS	1	AT				IS	SCHEDULED	TO	FINISH	AT	0.000	HOUR!
	ITEM	80002	ENTER	EC PROC	ESS .	1	AT					SCHEDULED				0.000	
	ITEM	80003	ENTER	ED PROC	ESS		AT					SCHEDULED				0.000	
	ITEM	80003	ENTER	ED PROC	ESS	32			HOURS						~,		TIO OTC.
	ITEM	80¢02	ENTER	EC PROC	SS	32	AT		HOURS					*			
	ITEM	80001	ENTER	ED PROCI	SS	44	AT		HOURS								
	ITEM	* 1001	ENTER	ED PROCE	:85	44	ÁT				15	SCHEDULED	TO	FINISH	ΑT	-000	HOUR
	ITEM	* 2001	ENTER	EC PROC	ESS 1	9 8	AT					SCHEDULED				-1.000	
	ITEM	* 3001	ENTER	ED PROCE	55 1	98	AT					SCHEDULED				-1.CCC	
	ITEM		ENTER	ED PROCE	SS 1	98	ΤA					SCHEDULED				-1.000	_
	ITEM		ENTER	ED PROCE	SS 1	98	AT					SCHEDULET				-1.000	
0	ITEM		ENTER	EC PROCI	SS 1	98	AT					SCHEDULEC				-1.0CC	
Ì,	ITEM	<b>* 13001</b>	ENTER	ED PROCE	ESS 1º	98	AT					SCHEDULED				-1.000	
õ	ITEM		ENTER	ED PROCE	S <u>S</u> 1	8	ΔT	-1.000	FOURS	AND	ΙS	SCHEDULED	TU	FINISH		-1.0CC	
	ITEM		ENTER	EC PROCE	<b>S</b> S	O	AT					SCHEDULED				-1.000	HOUR:
	ITEM			ED PROCE		10	ΑT					SCHEDULED					HOUR'
	ITEM		ENTER	ED PROCE	SS	32	AT		<b>FOURS</b>						-		
	ITEM			ED PROCE		32	ΑT	.000	HOURS						<b></b>	·· *	<del></del>
	ITEM		ENTER	ED PROCE	5.5	0	ΑT	-1.000	HOURS	AND	15	SCHEDULED	TO	FINISH	AT :	-1.000	HOUR
	ITEM			ED PROCI		32	AΤ					SCHEDULED					HOUR
	ITEM			ED PROCE		32	ΑŤ		HOURS								
		* 40000004				9	AT	•000	HOURS	AND	ΙS	SCHEDULED	TO	FINISH	ΑT	730.000	HOUR
· · ·	ITEM			EC PROCE		5	ΔŢ					SCHEDULED				-1.000	
		* 40000004				24	AT	730.000	HOURS	AND	IS	SCHEDULED	TO	FINISH	AT	730.000	HOUR
		<b>* 40000004</b>				27	ΑT	730.000	HOURS	AND	15	SCHEDULED	TO	FINISH	AT	730.000	HOUR
		* 4000CCC4				39	ΑT	730.000	HOURS	AND	15	SCHEDULED	TO	FINISH	ΑT	730.000	HOUR
	ITEM	_		ED PROCE		15	AT					SCHEOLLED				730.000	
	ITEM	40000004				5		730.000	<b>FOURS</b>	AND	15	SCHEDULED	TO	FINISH	AT	730.000	HOUR
	ITEM			ED PROCE		55		730.000	HOURS	AND	ΙŞ	SCHEDULED	To.	FINISH	AT	9298.948	HOUR:
		0.0	0.0	C. CCCOC			C	999999		O	Ö	-					
	73	C • G	0.0	0.00000	0		0	6599999		0	1					• •	

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40000004 ENTERED PROCESS 52 AT 730.000 HOURS AND IS SCHEDULED TO FINISH AT 738.000 HOURS
    ITEM
    ITEM
          40000004 ENTEREC PROCESS 11 AT 738.000 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                                747.600 HOUR
    ITEM
           4000CC04 ENTERED PROCESS
                                    13 AT
                                                 747.600 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                                 808.400 HOUR.
                                    19 AT
    ITEM
           40000004 ENTERED PROCESS
                                                 808.40G HOURS
    ITEM *
             201001 ENTERED PROCESS
                                        65 AT
                                                9298.948 HOURS AND IS SCHEDULED TO FINISH AT 10558.259 HOUR
                                        65 AT
    ITEM
              80001 ENTERED PROCESS
                                                9298.948 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                               9298-948 HCUR
             8.01C000E+02 1.063102E+C6 1.001002E+06 2.886831E+06
1.600126E+06
1.00000CE+00
   ITEM
              80001 ENTERED PROCESS
                                                9298.948 HOURS AND IS SCHEDULED TO FINISH AT
                                       104 AT
                                                                                               9298-948 HOUR
    ITEM
                                       2 AT
              80001 ENTERED PROCESS
                                                9298.948 HOURS
    ITEM *
             201001 ENTERED PROCESS
                                        65 AT
                                               10558.259 FOURS AND IS SCHEDULED TO FINISH AT 16957.931 HOUR
              80001 ENTERED PROCESS
    ITEM
                                        65 AT
                                               10558.259 HOURS AND IS SCHEDULED TO FINISH AT 10558.259 HOUR.
             9.010000E+02 2.035203E+06 1.002003E+06 8.771921E+06
1.600126E+06
1.00000CE+00
    ITEM
              80001 ENTERED PROCESS
                                       104 AT
                                               10558.259 HOURS AND IS SCHEDULED TO FINISH AT 10558.259 HOUR:
                                       2 AT 10558.259 HOURS
    TTEM
              80003 ENTERED PROCESS
    1.6562536E+57
                                          2.000000E+00
                        6.7780000E+02
                                                                 1.0000000E+00
                         9.0000000E-01
     8.CCC0000E+00
 ? ITEM
              80001 ENTERED PROCESS
                                         2 AT
                                               10558.259 HOURS AND IS SCHEDULED TO FINISH AT 10558.259 HOUR:
 2 ITEM
             80001 ENTERED PROCESS
                                        42 AT
                                               10558-259 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                              10558-259 HOUR!
    ITEM *
             . 1002 ENTERED PROCESS
                                        42 AT - 10558.259 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                              10558.255 HOUR
    ITEM
                                         2 AT
             80001 ENTERED PROCESS
                                               10558.259 FOURS AND IS SCHEDULED TO FINISH AT
                                                                                              1055 £ . 255 HOUR.
    LTEM
             80001 ENTERED PROCESS
                                        42 AT
                                               10558.259 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                              10558.259 HOUR.
    ITEM *
             - 2002 ENTERED PROCESS
                                        42 AT
                                               10558.259 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                              10558-259 HEUR:
    ITEM
              80001 ENTERED PROCESS
                                        2 AT
                                               10558.259 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                              10558.259 HOUR
                                               10558.259 HOURS AND IS SCHEDULED TO FINISH AT
    ITEM
              80001 ENTERED PROCESS
                                        42 AT
                                                                                              1055 E-259 HOUR.
    ITEM *
               5002 ENTERED PROCESS
                                        42 AT 10558-259 FOURS AND IS SCHEDULED TO FINISH AT
       1600126
                    -60008
                                 1063102
                                              1001002
                                                             80001
                                                                         288663
                     -80009
                                 2035203
             0
                                              1002003
                                                             80001
                                                                         877192
   ITEM
             80003 ENTERED PROCESS
                                         2 AT *10557.259 FOURS
                                         2 AT 10558.259 FOURS AND IS SCHEDULED TO FINISH AT 10558.259 HOUR
   ITEM
              80001 ENTERED PROCESS
    ITEM
             80001 ENTERED PROCESS
                                        30 AT
                                               10558-259 HOURS
   ITEM
              5002 ENTERED PROCESS
                                        30 AT
                                               10558 . 259 FOURS
   ITEM
              2002 ENTERED PROCESS
                                        30 AT
                                               10558.259 HOURS
   ITEM
              1002 ENTERED PROCESS
                                        30 AT
                                               10558-259 HOURS
             80001 ENTERED PROCESS
                                        30 AT
                                               10558.259 FOURS AND IS SCHEDULED TO FINISH AT
   ITEM *
                                                                                              10558.259 HOUR
   ITEM * 30000003 ENTERED PROCESS
                                        19 AT
                                               10558.255 FOURS AND IS SCHEDULED TO FINISH AT
                                                                                              11288.255 HOUR
                                        4 AT
                                                  -1.000 HOURS AND IS SCHEDULED TO FINISH AT
   ITEM *
             80001 ENTEREC PROCESS
                                                                                                 -1.000 HOUR
   ITEM * 30000003 ENTERED PROCESS
                                        24 AT
                                               11288.259 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                              11288.259 HOUR
   ITEM * 30000003 ENTERED PROCESS
                                        27 AT
                                               11288-259 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                              11288.255 HOUR
   ITEM * 30000003 ENTERED PROCESS
                                        39 AT
                                               11288.255 FOURS AND IS SCHEDULED TO FINISH AT
                                                                                              11288.255 HCUR
                                        45 AT
   ITEM * 30000003 ENTERED PROCESS
                                               11238.259 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                              11288.260 HEUR
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65 AT 11288-260 HOURS AND IS SCHEDULED TO FINISH AT 16557-531 HOUR.
   ITEM * 201COL ENTERED PROCESS
                                    66 AT 11288.260 HOURS AND IS SCHEDULED TO FINISH AT 1128E.26C HOUR
   ITEM * 3CCCCCCC3 ENTERED PROCESS
                                          11288.26G HOURS AND IS SCHEDULED TO FINISH AT 11296.26G HOUR
   ITEM * 30000003 ENTERED PROCESS
                                    52 AT
                                    11 AT 11296.260 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                    11305.EEC HOUR
   ITEM * 30000003 ENTERED PROCESS
                                    13 AT
                                                                                    11315.860 HOUR
                                          11305.860 HOURS AND IS SCHEDULED TO FINISH AT
   ITEM # 80001 ENTERED PROCESS
                                          11305.860 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                    11366.66C HOUR
          3CCCCCC3 ENTERED PROCESS
                                    13 AT
   ITEM
                                  5 AT 11315.860 HOURS AND IS SCHEDULED TO FINISH AT 11315.860 HOUR:
   ITEM 80001 ENTERED PROCESS
                                     5 AT 11315.860 HOURS AND IS SCHEDULED TO FINISH AT 11315.860 HOUR
   ITEM *
            5001 ENTERED PROCESS
   ITEM
            80001 ENTERED PROCESS
                                     2 AT 11315.860 HOURS
   ITEM * 5001 ENTERED PROCESS
                                   15 AT 11315.860 HOURS AND IS SCHEDULED TO FINISH AT 11315.861 HOUR!
                                 15 AT 11315.860 HOURS AND IS SCHEDULED TO FINISH AT 11315.861 HOUR!
   ITEM # 2001 ENTERED PROCESS
           1001 ENTERED PROCESS
                                   15 AT 11315.860 HOURS AND IS SCHEDULED TO FINISH AT 11315.861 HOUR
   ITEM
   ITEM___
            1001 ENTERED PROCESS
                                  197 AT 11315.861 HOURS
                                  197 AT 11315.861 HOURS
             2001 ENTERED PROCESS
   ITEM
   ITEM
             5001 ENTERED PROCESS
                                   197 AT 11315.861 HOURS
  ITEM 3000003 ENTERED PROCESS 19 AT 11366.660 HOURS
                                   65 AT 16957.931 HOURS AND IS SCHEDULED TO FINISH AT 47348.978 HOUR
   ITEM *
           201001 ENTERED PROCESS
                                   65 AT 16957.931 HOURS AND IS SCHEDULED TO FINISH AT 16957.921 HOUR
   ITEM
            80001 ENTERED PROCESS
1.600126E+06 1.101000E+03 2.045201E+06 1.002003E+06 9.512910E+05
1.0C00CE+00
                                   104 AT 16957.931 HOURS AND IS SCHEDULED TO FINISH AT 16957.931 HOUR!
   ITEM
            80001 ENTERED PROCESS
 O ITEM
          80001 ENTERED PROCESS 2 AT 16957.931 HOURS
 2 ITEM *
           201001 ENTERED PROCESS 65 AT 47348.978 HOURS AND IS SCHEDULED TO FINISH AT 50859.592 HOUR
                                65 AT 47348.978 HOURS AND IS SCHEDULED TO FINISH AT 47348.978 HOUR
   ITEM
            80001 ENTEREC PROCESS
1.600126E+C6 1.101000E+03 1.C47102E+C6 1.001002E+06 1.052631E+06
1.00000CE+00
                                   104 AT 47348.978 HOURS AND IS SCHEDULED TO FINISH AT 47348.578 HOUR
   ITEM
            80001 ENTERED PROCESS
                                   2 AT 47348.978 HOURS
            80001 ENTERED PROCESS
                                                          ,
   ITEM
    50859.6
                 0.0 0.00000
                                   C
                                          559999 0
                                                             0
0
                                          50130
                                                        0 1
              50129.6 1.000000
                                   50130
1
    C.O
 ITEM * 201001 ENTERED PROCESS 65 AT 50859.592 HOURS AND IS SCHEDULED TO FINISH AT 62953.243 HOUR
                                  65 AT 50859.592 HOURS AND IS SCHEDULED TO FINISH AT 50859.592 HOUR
          80001 ENTERED PROCESS
1.600126E+06 1.100000E+03 2.045201E+C6 2.002003E+06 1.000000E+00
0.
                                   104 AT 50859.592 HOURS AND IS SCHEDULED TO FINISH AT 50859.592 HOUR.
   ITEM
            80001 ENTERED PROCESS
            80003 ENTERED PROCESS
                                     2 AT 50859.592 HOURS
   ITEM
                                     1.000000E+00 1.0000000E+00
    1.6962536E+57 2.572C000E+02
    7.000000E+00
                   9.0C00000E-01
                                  2 AT 50859.592 HOURS AND IS SCHEDULED TO FINISH AT 50855.592 HOUR
            80001 ENTERED PROCESS
   ITEM
                                          50859.592 HOURS AND IS SCHEDULED TO FINISH AT 50859.592 HOUR
                                    42 AT
   ITEM
          - 80001 ENTERED PROCESS
                                          30859.592 HOURS AND IS SCHEDULED TO FINISH AT 50859.592 HOUR
   ITEM # 4002 ENTERED PROCESS
                                    42 AT
                                  2 AT 50859.592 HOURS AND IS SCHEDULED TO FINISH AT 50859.592 HEUR
    ITEM
            80001 ENTERED PROCESS
```

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ITEM
              80001 ENTERED PROCESS
                                         42 AT
                                                50859.592 HOURS AND IS SCHEDULED TO FINISH AT 50859.592 HOUR
    ITEM *
               5003 ENTERED PROCESS
                                         42 AT
                                                50859.592 HOURS AND IS SCHEDULED TO FINISH AT
       1600126
                     -70011
1
                                  2045201
                                               2002003
                                                               80001
                                                                                0
                                                                                       1
2
                                  1047102
                                               1001002
                                                                           105263
    ITEM
              80003 ENTERED PROCESS
                                          2 AT *50858.592 HOURS
    ITEM
              80001 ENTERED PROCESS
                                                50859.592 HOURS AND IS SCHEDULED TO FINISH AT
                                          2 AT
    ITEM
              80001 ENTERED PROCESS
                                         30 AT
                                                50859.592 FOURS
    ITEM
               5003 ENTERED PROCESS
                                         30 AT
                                                50859.592 HOURS
    ITEM
               4002 ENTERED PROCESS
                                         30 AT
                                                50859.592 HOURS
    ITEM *
              80001 ENTERED PROCESS
                                         30 AT
                                                50859.592 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                                50855.552 HOUR
    ITEM * 20000002 ENTERED PROCESS
                                                50859.592 HOURS AND IS SCHEDULED TO FINISH AT-
                                         19 AT
                                                                                                51565.592 HOUR
    ITEM *
              80001 ENTERED PROCESS
                                          3 AT
                                                   -1.000 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                                    -1.CGC HOUR
    ITEM * 20000002 ENTERED PROCESS
                                         24 AT
                                                51589.592 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                                 51589.592 HOUR
                                                51589.592 FOURS AND IS SCHEDULED TO FINISH AT
    ITEM * 20000002 ENTERED PROCESS
                                         27 AT
                                                                                                 51589.592 HOUR
    ITEM * 20000CO2 ENTERED PROCESS
                                         39 AT
                                                51589.592 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                                51589.592 HCUR
                                                51589.592 HOURS AND IS SCHEDULED TO FINISH AT
    ITEM * 20000CC2 ENTERED PROCESS
                                         45 AT
                                                                                                 51589.552 HOUR
             201001 ENTERED PROCESS
    ITEM *
                                         65 AT
                                                51589.592 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                                63642.647 HOUR
                  730.0
                                          730
                                                                 C
         0.0
                            .014353
                                                    730
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     51589.6
                50129.6
                            .985647
                                        50130
                                                  50130
                                                                 0
  N ITEM * 20000002 ENTERED PROCESS
                                         66 AT
                                                51589.592 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                                51589.592 HOUR
    ITEM * 20000002 ENTERED PROCESS
                                                51589.592 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                                51597.592 HOUR
                                                51397.592 HOURS AND IS SCHEDULED TO FINISH AT
    ITEM * 20000002 ENTERED PROCESS
                                         11 AT
                                                                                                51667-192 HOUR
    ITEM *
              80001 ENTERED PROCESS
                                         13 AT
                                                51607.192 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                                51617.192 HCUR
    ITEM
           20000002 ENTERED PROCESS
                                         13 AT
                                                51607.192 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                                51667.552 HOUR
    ITEM
              80001 ENTERED PROCESS
                                          5 AT
                                                51617.192 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                                51617-192 HOUR
    ITEM *
               5002 ENTERED PROCESS
                                          5 AT
                                                51617.192 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                                51617.192 HOUR
    ITEM
              80001 ENTERED PROCESS
                                          2 AT
                                                51617.192 FOURS
    ITEM *
               5002 ENTERED PROCESS
                                         15 AT
                                                51617.192 HOURS AND IS SCHEDULED TO FINISH AT
                                                                                                51617.193 HOUR
               4CO1 ENTERED PROCESS
                                                51617.192 HOURS AND IS SCHEDULED TO FINISH AT 51617.193 HOUR
    ITEM
                                         15 AT
    ITEM
               4001 ENTERED PROCESS
                                        197 AT
                                                51617.193 HOURS
    ITEM
               5002 ENTERED PROCESS
                                        197 AT
                                                51617-193 HOURS
    ITEM
           20000002 ENTERED PROCESS
                                         19 AT
                                                51667.992 FOURS
    ITEM *
             201001 ENTERED PROCESS
                                         65 AT
                                                63643.647 HOURS AND IS SCHEDULED TO FINISH AT 63761.856 HOUR:
                                                63643.647 FOURS AND IS SCHEDULED TO FINISH AT 63643.647 HOUR.
    ITEM
              80001 ENTERED PROCESS
                                         65 AT
1.600126E+66
              2.001000E+03
                            3.045102E+C6 1.CU3006E+O6 9.999999E+07
1.CC000CE+00
    ITEM
              80001 ENTERED PROCESS
                                        104 AT
                                                63643.647 HOURS AND IS SCHEDULED TO FINISH AT 63643.647 HOUR
              80001 ENTERED PROCESS
    ITEM
                                          2 AT
                                                63643.647 FOURS
    ITEM *
             201001 ENTERED PROCESS
                                         65 AT
                                                637ol.856 HOURS AND IS SCHEDULED TO FINISH AT 65149.233 HOUR
    ITEM
              80001 ENTERED PROCESS
                                         65 AT 63761.856 HOURS AND IS SCHEDULED TO FINISH AT 63761.856 HOUR
1.600126E+06
              2.101000E+03 1.057301E+06 1.001002E+06 3.091191E+06
1.0000CCE+00
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ITEM 80CO1 ENTERED PROCESS
                                     104 AT 63761.856 HOURS AND IS SCHEDULED TO FINISH AT 63761.856 HOUR.
              80001 ENTERED PROCESS
    ITEM
                                       2 AT 63761.856 HOURS
    ITEM *
             201COL ENTERED PROCESS
                                       65 AT 65149.233 HOURS AND IS SCHEDULED TO FINISH AT 65915.148 HOUR
    ITEM
              80001 ENTERED PROCESS
                                       65 AT 65149.233 FOURS AND IS SCHEDULED TO FINISH AT 65149.233 HOUR
1.600126E+06
              2.001000E+03 1.047201E+C6 1.001002E+06 1.052631E+06
1.CCCOCCE+CO
    ITEM
              80001 ENTERED PROCESS 104 AT 65149-233 HOURS AND IS SCHEDULED TO FINISH AT 65149-233 HOUR
    ITEM
              80001 ENTERED PROCESS
                                        2 AT 65149.233 HOURS
    ITEM *
             201001 ENTERED PROCESS
                                       65 AT 69915.148 HOURS AND IS SCHEDULED TO FINISH AT 73455.426 HOUR
    ITEM
              80001 ENTERED PROCESS
                                       65 AT 69915.148 HOURS AND IS SCHEDULED TO FINISH AT 69915.148 HOUR
1.600126E+06
             2.C01000E+03 1.043102E+C6 1.001002E+06 2.158891E+06
1.CC000CE+00
    ITEM
              80001 ENTERED PROCESS
                                      104 AT
                                              69915.148 HOURS AND IS SCHEDULED TO FINISH AT 69915.148 HOUR.
    ITEM
              80001 ENTERED PROCESS
                                        2 AT
                                              69915-148 HOURS
    ITEM *
             201001 ENTERED PROCESS
                                       65 AT 73459.426 HOURS AND IS SCHEDULED TO FINISH AT. 74270.332 HOUR!
                                      65 AT 73459.426 HOURS AND IS SCHEDULED TO FINISH AT 73459.426 HOUR
    ITEM
             80001 ENTERED PROCESS
1.600126E+C6 1.401000E+03 1.073101E+C6 1.001002E+06 1.818181E+06
1.CC000GE+00
    ITEM
             80001 ENTERED PROCESS
                                      104 AT 73459.426 HOURS AND IS SCHEDULED TO FINISH AT 73459.426 HOUR
  OTTEM
              80001 ENTERED PROCESS
                                        2 AT 73459.426 HOURS
  N ITEM *
             201001 ENTERED PROCESS
                                       65 AT 74270.332 HOURS AND 15 SCHEDULED TO FINISH AT 75183.468 HOUR
  Mati 4
              80001 ENTERED PROCESS
                                       65 AT 74270.332 HOURS AND IS SCHEDULED TO FINISH AT 74270.332 HOUR
1.600126E+06
             2.001000E+03 3.045102E+C6 2.003006E+06 9.999999E+07
1.CC00C0E+00
    ITEM
             80001 ENTERED PROCESS
                                      104 AT - 74270.332 HOURS AND IS SCHEDULED TO FINISH AT 74270.332 HOUR
    ITEM
             80001 ENTERED PROCESS
                                        2 AT 74270.332 HOURS
             201001 ENTERED PROCESS
    ITEM *
                                       65 AT 75183.468 HOURS AND IS SCHEDULED TO FINISH AT 75567.777 HOUR.
                                       65 AT 75183.468 HOURS AND IS SCHEDULED TO FINISH AT 75183.468 HOUR
    ITEM
              80001 ENTERED PROCESS
1.600126E+06
             2.C01000E+03 3.045102E+66 3.003006E+06 1.998110E+05
1.C00000E+00
    ITEM
             80001 ENTERED PROCESS
                                      104 AF 75183.468 FOURS AND IS SCHEDULED TO FINISH AT 75182.468 HOUR
    ITEM
             80001 ENTERED PROCESS
                                        2 AT 75183.468 HOURS
    ITEM *
            201001 ENTERED PROCESS
                                       65 AT 75567.777 HOURS AND IS SCHEDULED TO FINISH AT 75929.324 HOLR
    ITEM
             80001 ENTERED PROCESS
                                       65 AT 75567.777 HOURS AND IS SCHEDULED TO FINISH AT 75567.777 HOUR
1.600126E+06 2.C01000E+03 1.C47102E+C6 1.D01002E+06 1.052631E+06
1.C00000E+00
    ITEM
             80001 ENTERED PROCESS
                                      104 AT 75567.777 HOURS AND IS SCHEDULED TO FINISH AT 75567.777 HOUR
    ITEM
             80001 ENTERED PROCESS
                                        2 AT 75567.777 HOURS
    75929.3
0
                 730.0
                          307P20.
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        0.0
1
               74469.3 .990292
                                      50130
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                                                24340
                                                             0
    ITEM *
            201001 ENTERED PROCESS
                                      65 AT
                                             75929.324 HOURS AND IS SCHEOULED TO FINISH AT 65824.557 HOUR.
    ITEM
             80001 ENTERED PROCESS
                                     65 AT 75929.324 HOURS AND IS SCHEDULED TO FINISH AT 75929.324 HOUR
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1.600126E+C6 2.C00000E+03 3.045102E+C6 4.0030C6E+06 1.CC0C00E+00
      ITEM
                      80001 ENTERED PROCESS
                                                                104 AT 75929.324 HOURS AND IS SCHEDULED TO FINISH AT 75929.324 HOUR
                      80CC3 ENTERED PROCESS 2 AT 75929.324 HOURS
   ITEM
        1.6962536E+57
                                        1.8562CGGE+C3
                                                                         3.000000E+00
                                                                                                       1.00000C0E+00
        9.000000E+00
                                        9-0000000E-01
      ITEM 80001 ENTERED PROCESS
                                                            2 AT 75929.324 HOURS AND IS SCHEDULED TO FINISH AT 75925.324 HOUR
      ITEM
                      80001 ENTERED PROCESS
                                                                 42 AT 75929.324 HOURS AND IS SCHEDULED TO FINISH AT 75929.324 HOUR
      ITEM *
                   13002 ENTERED PROCESS
                                                                 42 AT 75929.324 HOURS AND IS SCHEDULED TO FINISH AT 75929.324 HOUR
                  80001 ENTERED PROCESS
      ITEM
                                                                2 AT 75929.324 HOURS AND IS SCHEDULED TO FINISH AT 75929.324 HOUR
      ITEM 80001 ENTERED PROCESS
                                                                 42 AT 75929.324 HOURS AND IS SCHEDULED TO FINISH AT 75925.324 HOUR
      ITEM * 5004 ENTERED PROCESS 42 AT 75929.324 HOURS AND IS SCHEDLLED TO FINISH AT 75929.324 HOUR ITEM 80001 ENTERED PROCESS 2 AT 75929.324 HOURS AND IS SCHEDULED TO FINISH AT 75929.324 HOUR
      ITEM 80001 ENTERED PROCESS 42 AT 75929.324 HOURS AND IS SCHEDULED TO FINISH AT 75929.324 HOUR ITEM * 4003 ENTERED PROCESS 42 AT 75929.324 HOURS AND IS SCHEDULED TO FINISH AT 75929.324 HOUR
        16C0126 -50014 1073101 1001002 EC001 1E181E 1
                     0 -50021
                                                   1057301 1001002 80001
                                                                                                                      309119
                                            30451(2 4CC3006 E0001 C 3
1C472C1 1001002 0 105263 4
1C471C2 1C01002 0 105263 5
1043102 1CC1002 0 215889 6
                              -90020
                                                                                                                    215889 6
                                          0
      ITEM 8CC03 ENTERED PROCESS 2 AT *75928.324 HOURS
                                                          2 AT 75929.324 HOURS AND IS SCHEDULED TO FINISH AT 75929.324 HOUR.
               80001 ENTERED PROCESS
      ITEM
     | ITEM | 80001 ENTERED PROCESS | 30 AT | 75929.324 HOURS | 1TEM | 4003 ENTERED PROCESS | 30 AT | 75929.324 HOURS | 1TEM | 5004 ENTERED PROCESS | 30 AT | 75929.324 HOURS | 1TEM | 13002 ENTERED PROCESS | 30 AT | 75929.324 HOURS | 1TEM | 80001 ENTERED PROCESS | 30 AT | 75929.324 HOURS | AND | 15 SCHEDU | 1TEM | 80001 ENTERED PROCESS | 30 AT | 75929.324 HOURS | AND | 15 SCHEDU | 1TEM | 80001 ENTERED PROCESS | 30 AT | 75929.324 HOURS | AND | 15 SCHEDU | 1TEM | 80001 ENTERED PROCESS | 30 AT | 75929.324 HOURS | AND | 15 SCHEDU | 1TEM | 800010001 ENTERED PROCESS | 30 AT | 75929.324 HOURS | AND | 15 SCHEDU | 1TEM | 800010001 ENTERED PROCESS | 30 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHEDU | 15 AT | 75929.324 HOURS | AND | 15 SCHED
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                                  197 AT 76686.925 HOURS
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             5003 ENTERED PROCESS
                                   197 AT 76686.925 HOURS
   ITEM
             4002 ENTERED PROCESS
                                 19 AT 76737.724 HOURS
  ITEM
        10000CG1 ENTERED PROCESS
                                    65 AT 78281.928 HOURS AND IS SCHEDULED TO FINISH AT 82362.002 HOUR.
   ITEM *
            201001 ENTERED PROCESS
                                    65 AT 78281.928 HOURS AND IS SCHEDULED TO FINISH AT 78281.928 HOUR
   ITEM
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1.600126E+06 2.401000E+03 3.045102E+C6 1.003006E+06 9.999999E+07
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                                    65 AT 82362.002 HOURS AND IS SCHEDULED TO FINISH AT 82959.271 HOUR
   ITEM *
            201CQ1 ENTERED PROCESS
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                                    65 AT
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             80001 ENTERED PROCESS
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             80001 ENTERED PROCESS
                                    65 AT 88298.068 HOURS AND IS SCHEDULED TO FINISH AT 92963.739 HOUR
   ITEM *
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   ITEM
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            201GG1 ENTEREC PROCESS
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SIMULATION		SERVICE	OPERATING_	PERCENTAGE	SIMULATION	
NO.	SATELLITES	FLIGHTS	1 SAT.	O SAT.	NO.	
1	0	3	98.333	1.667	·•	· · · · · · · · · · · · · · · · · · ·
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4	0	4	98.333	1.667		the commence of the comment of the c
5	0	2	99.167	.833	· 5	,
6	Ō	6	97.500	2.500	<i>5</i>	
7	C	4	97.500	2.500	· · · · · · · · · · · · · · · · · · ·	
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12	Ö	6	97.500	2.500	12	
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14	Ö	3	97.500	2.500	14	•
15 16	C	Ž	99-167	.833	15	•
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17	C .	. 2	99.167	.833	17	
18	0	2	98.333	1.667	18	
19	0	2	99.167	. 833	19	and the second s
20	C	. 4	58.333	1.667	20	
21	Ů.	3	98.333	1.667	21	
22	0	4	98.333	1.667	22	The second secon
23	G	i	99.167	.833	23	
24	. 0	- 5	97.500	2.500	24	·
25	C	3	99.167	.833	25	
26	0	3	96.893	3.107	26	
27	0	3	98.333	1.667	27	
28	0	5	57.500	2.500	28	and the state of t
25	o	4	99.167	.833	29	
30	0	2	58.333	1.667	30	
31	O	3	98.333	1.667	31	A CONTRACTOR OF THE STATE OF TH
3.2	. 0	. 1	99.167	.833	32	•
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35	C	2	58.333	1.667	35	

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SIMULATION	REPLACEMENT	SERVICE	<b>OPERATING</b>	D C D C C NT ACC	SIMULATION		
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72	C	5	95.833	4.167	72		
73			96.667	3.333	73		
74	0 0	4	57 <b>.</b> 500	2.500	74 75		
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# \*\*\*\*\* AVAILABILITY \*\*\*\*\*

THERE	WERE 100 MISSIONS WHICH AC	CCUMULATED 8760000 CPERATING HOURS IN ORBIT.	
THERE ARE	MINIPUM		
C-30	AVERACE MAXIMUM STANCARD DEVIATION	M 5.00 PERCENT	,
THERE ARE	MINIMUM	R 98.C70 PERCENT OF THE TIME. M 95.00 PERCENT E 98.C7 PERCENT	
The second secon		1 100.00 PERCENT	

*** FRECUENCY DISTRIBUTION OF SHUTTLE LAUNCHES REQUIRED ***	*
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	***	SHUT	TLE L	AUNCH	TIME	DIST	RIBUTI	ION *	<b>*</b> *											-
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## \*\*\*\* SERVICE FLIGHT INITIATION STATISTICS \*\*\*\*

## THERE IS AN AVERAGE OF 3.43 SERVICE FLIGHTS PER MISSION

## 100.00 PERCENT WERE DUE TO AN SRU REACHING A MANDATORY STATE

0.00 PERCENT WERE IN STATE

0.00 PERCENT WERE IN STATE

45.48 PERCENT WERE IN STATE

32.65 PERCENT WERE IN STATE 8

21.87 PERCENT WERE IN STATE 9

### C.00 PERCENT WERE DUE TO THE TUG WEIGHT LIMIT BEING REACHED

0.00 PERCENT WERE DUE TO THE SERVICE UNIT STORAGE LIMIT BEING REACHED

## SATELLITE DOWN

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FINIMUM = 1.00

AVERAGE = 3.43

00.8 = MUMIXA4

STD DEV = 1.51

## TUG WEIGHT LIMIT REACHED

O.OO = MUMIGIA

AVERAGE = 0.00

MAXIMUM = 0.00

STD DEV = 0.00

#### STORAGE LIMIT, REACHED

0.00 = MUMINIM

 $\angle VERAGE = 0.00$ 

MAXIMUM = 0.00

STD DEV = 0.00

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***	SRU	REPLACEMENT	WEIGHT	CISTRIBUTION	PER	SERVICE	FLIGHT	* * *

WEIGHT WEIGHT	240	27C	300	330	360	390	420	45C	480	510	54C	570	600	630	660	<b>69</b> 0	720	750	780	81 <u>C</u>
OCCURNO NORM CUM	0.00	.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WEIGHT WEIGHT	240	270	300	330	360	_3\$0	420	450	480	510	540	570	600	630	660	690	720	, 750	78 G	810
WEIGHT WEIGHT		870		930		990		1050		1110		1170		1230		1290		1350		1410
OCCURNO O NORM	0.00	0.00	0.00	0.00	0.00	0.00	C. CO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	. 32	0.00	0.00	0.00	0.00
MEIGHT WEIGHT		870	900	930	<b>\$</b> 60	<b>990</b> .	1020	1050	1080	1110	1140	1170	1200	1230	1260	1290	1320	1350	1380	1410
WEIGHT WEIGHT	1440	147C	1500	1530	1560	1590	1620	1650	1680	1710	1746	1770	1800	1830	1860	1890	1920	1950	1980	2010
OCCURNO NORM	0.00	3.06	0 C• 0 0	47		C. CO	.17	0.00	0.00	11	.91	16	0.00	26 •55	3_	<u>1</u>	2	1	21	40
WEIGHT WEIGHT		1470		1530	<del></del>	1590		1650		1710		1770		1830		1890	· · · · · · · · · · · · · · · · · · ·	1950	<del></del> -	2010
WEIGHT WEIGHT	2040	2076	2166	2130	2160	2190	2220	2250	2280	2310	2340	2370	2400	2 <b>4</b> 3C	2460	2490	2520	2550	2580	2610
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(EIGHT	2040	2070	2100	2130	2160	2190	2220	<u>22</u> 50	2280	2310	2340	2370	2400	2430	2460	2490	2520	2550	2580	2610
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# APPENDIX D ASSESSMENT OF ADVANCED MISSIONS

#### APPENDIX D

## ASSESSMENT OF ADVANCED MISSIONS

## 1. INTRODUCTION

The body of this report has considered a basic EOS-type mission implemented with a single satellite having a single instrument. Two advanced missions have been conceived to yield more frequent coverage with two instruments:

- a) A single satellite with tandem instruments operating simultaneously to image adjacent swaths
- b) Two satellites, with one instrument each, with orbit positions phased to provide imaging of adjacent swaths.

Cost data for these advanced missions has been developed from the resupply/retrieval costs presented for the basic mission.

# 1.1 Single Satellite with Two Sensors

Costs for this mission have been derived using the following procedures:

- a) The number of low flights is increased by 30 percent to account for the estimated increase in payload failure rate
- b) The number of high flights is unchanged, since there are no additional failures that would prevent orbit transfer
- c) The rework costs are increased by 30 percent for both retrieval and resupply
- d) The spacecraft cost (new) is increased by \$5 M
- e) The launch vehicle payload weight is increased by 15 percent on all flights.

With groundrules a), b), and c), the revised launch costs ( $C_L^*$ ) are given in terms of the original launch costs ( $C_I$ ) by:

$$C_L^* = 1.15 \left(1 + \frac{0.3\eta_L}{4\eta_H + \eta_L}\right) C_L$$

where  $\eta_{L}$  is the original number of low flights and  $\eta_{H}$  is the number of high flights.

# 1.2 Two Satellites with One Sensor Each

For this mission, the costs have been estimated using the groundrules summarized below:

- a) Rework costs and new satellite costs are doubled
- b) For a retrieval maintenance approach launch, costs double
- c) For resupply it is assumed that both satellites can be serviced on a single flight one half of the time.

The resupply launch costs are then the average of the costs where one satellite is serviced per flight:

$$C_L^* = 2 C_L$$

and the costs when both satellites are serviced on a single flight

$$C_{L}^{*} = \frac{W_{FSS} + 2\overline{W}}{W_{FSS} + \overline{W}} C_{L}$$

where  $W_{FSS} = 2472$  pounds and  $\overline{W}$  is the average Shuttle payload on resupply flight (here taken as 1300 pounds). Then

$$\overline{C_L^*} = 1.672 C_L$$

## 2. RESULTS

Figure D-1 shows the resupply and retrieval mission costs for the three mission types evaluated. For double coverage, the singlesatellite/tandem-instrument approach is least costly. However, it will not provide the availability levels achievable with the dual satellite scheme.

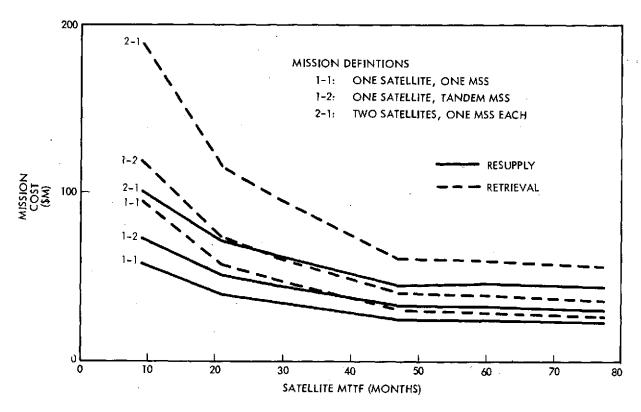


Figure D-1. Mission Costs with Servicing: Alternate Missions